DOCUMENT RESUME

ED 258 418 EC 172 938

AUTHOR Giangreco, Michael F.
TITLE Basic Environmental Control Devices for Persons with Severe Multiple Handicapping Conditions.
INSTITUTION Tompkins-Seneca-Tioga Board of Cooperative Educational Services, Ithaca, N.Y.
SPONS AGENCY Foundation for Exceptional Children, Reston, Va.
PUB DATE Apr 85
NOTE 76p.; Paper based on document was presented at the Annual Convention of the Council for Exceptional Children (63rd, Anaheim, CA, April 15-19, 1985).
AVAILABLE FROM National Clearinghouse of Rehabilitation Training Materials, 115 Old USDA Building, Oklahoma State University, Stillwater, OK 74078 ($4.50).
PUB TYPE Speeches/Conference Papers (150) -- Guides - Non-Classroom Use (055)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS *Electromechanical Aids; Elementary Secondary Education; *Multiple Disabilities; Sensory Aids; *Severe Disabilities

ABSTRACT

The guide presents a non-technical approach to adapting battery-operated and electrical devices for persons with severe handicapping conditions. The material was developed through Project REACH (Reconstructive Equipment Adaptations for Children with Handicaps). Chapter 1 presents rationales for the use of adapted switches and devices, including such considerations as environmental control, motivation, and encouragement of motor, social, and cognitive development. The next four chapters portray through text and illustrations the following procedures: (1) assembling remote control switches, (2) mounting miniature remote control switches for use by persons with handicaps, (3) adapting battery-operated devices for use with remote control switches, and (4) building a switch interface relay. (CL)

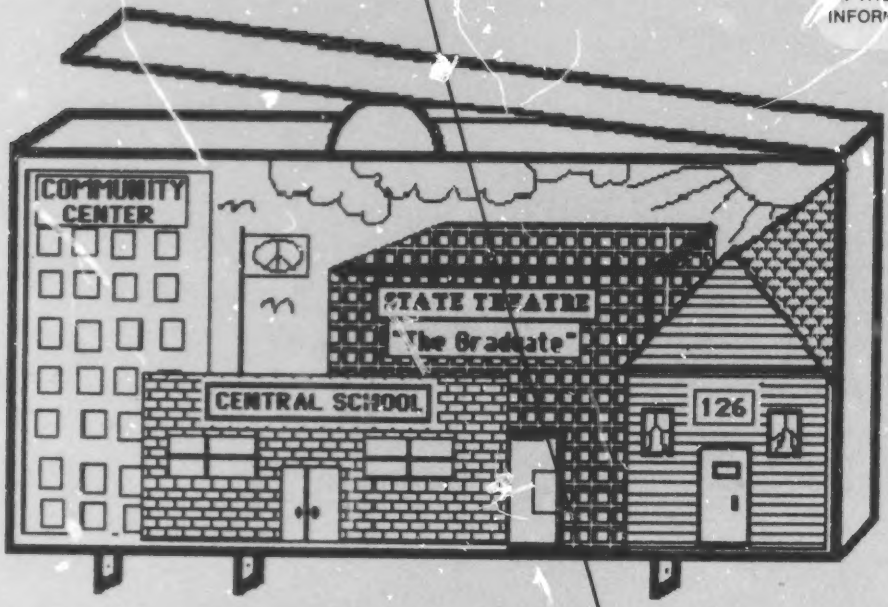
****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED258418

BASIC ENVIRONMENTAL CONTROL DEVICES FOR PERSONS WITH SEVERE MULTIPLE HANDICAPPING CONDITIONS

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Michael F. Giangreco
THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."



MICHAEL F. GIANGRECO

EC174438

BASIC ENVIRONMENTAL CONTROL DEVICES FOR PERSONS WITH SEVERE MULTIPLE HANDICAPPING CONDITIONS

Michael F. Giangreco Ed.S.

1985

Disseminated by

National Clearinghouse of Rehabilitation Training Materials
115 Old USDA Building
Oklahoma State University
Stillwater, Oklahoma 74078

(405) 624-7650

The preparation of this book was supported by **Project REACH** (Reconstructive Equipment Adaptations for Children with Handicaps), funded by the Foundation for Exceptional Children, Reston, Virginia and the Special Education Training and Resource Center of the Tompkins-Seneca-Tioga Board of Cooperative Educational Services, Ithaca, New York.

SPECIAL THANKS to Kevin Drake of the T-S-T BOCES Educational Communications Center. His technical expertise has benefited many children with handicapping conditions. The writer also wishes to thank Trisha Flaccus and Kim Phillips of the T-S-T BOCES Special Education Training and Resource Center for their hours of work assisting in the preparation of this book, and to the members of our classroom team who assisted in countless ways, Leslie Schultz, Laura Valentino-Argus, Mary Ryan, Kathy Byers-Hinkley, Sue Upcraft, Bev Hartz, Marlene Holcomb, and Sandy Worden. Finally a heartfelt thank you to Debbie Sharpe Giangreco, her assistance and support throughout the many months spent preparing this book were invaluable.

[Paper presented at the Annual Convention

of the

Council for Exceptional Children

(63rd, Anaheim, CA, April 15-19, 1985)]

TABLE OF CONTENTS

Introduction i
Project REACH ii

CHAPTER ONE 1
RATIONALES FOR THE USE OF ADAPTED SWITCHES AND DEVICES 2
Is An Adapted Switch Needed ? 2
Environmental Control 3
Development of a Response Mode 3
Partial Participation 3
Functional Alternatives 4
Multiplicity of Purpose 4
Motivation 5
Justification for More Sophisticated Equipment 5
Encouraging Cognitive Development 5
Encouraging Motor Development 5
Encouraging Social Skills 6
Encouraging Domestic,Leisure,Community, & Vocational Skills 6
References 7

CHAPTER TWO 8
ASSEMBLING REMOTE CONTROL SWITCHES 9
Understanding the Simple Circuit 9
Simple Unadapted Circuit (Open) 9
Simple Unadapted Circuit (Closed) 10
Simple Open Extended Circuit (Nondetachable) 10
Simple Open Extended Circuit (Detachable) 11
Simple Closed Extended Circuit (Detachable) 12
Types of Switches 12
Assembly of Switches with Interface Plug Component 12
Steps for Assembly of Switch Interface Plug Component 13
Using Heat Shrink Tubing 14
Lever or Lever Roller Switch 16
Option I (Single Switch,Normally Open/NO) 16
Option II (Single Switch,Normally Closed/NC) 17
Option III (Multiple Switches Wired in Parallel/NO) 17
Option IV (Single Wired Both NO & NC) 19
Option V (Two Switches Wired in Series) 20

Push ON - Push OFF Switch (SPST Soft Feel)..... 20
Mercury Switch (Bulb Type)..... 21
Option I (Single Switch)..... 21
Option II (Double Mercury Switch in Series)..... 22
Option III (Multiple Mercury Switches in Series)..... 23
Option IV (Three Terminal Mercury Switch Wired NO & NC)..... 24
References..... 25

CHAPTER THREE..... 27
MOUNTING MINIATURE REMOTE CONTROL SWITCHES FOR USE BY PERSONS WITH HANDICAPPING CONDITIONS..... 28
Surface Area/Size..... 28
Portability..... 29
Durability..... 29
Age-Appropriateness..... 29
Learner Preferences and Characteristics..... 30
Planes of Contact/Control..... 32
Stabilization..... 36
Sensitivity..... 36
Recoil..... 38
Safety..... 39
Texture..... 39
Cleanability..... 39
Novelty..... 39
Providing Options..... 41

CHAPTER FOUR..... 42
ADAPTING BATTERY-OPERATED DEVICES FOR USE WITH REMOTE CONTROL SWITCHES..... 43
Selection of Equipment for Adaptation..... 43
Directions for Internal Permanent Adaptation..... 45
External Permanent Adaptation..... 49
Permanent 9V Adaptation..... 50
Nonpermanent Adaptation..... 51
Adaptation of Devices Which Have More Than One Switch..... 52

Adaptation of Electrical Devices with Built-In Transformers.....52
Trouble Shooting.....55

CHAPTER FIVE.....56
BUILDING A SWITCH INTERFACE RELAY (SIR).....57
Assembling a Switch Interface Relay.....57
Consumable Materials Required.....58
Wiring Diagram of Switch Interface Relay.....63
Reference.....66

INTRODUCTION

This guide is designed for use by teachers, parents, therapists, and others who are interested in adapting battery-operated and electrical devices for persons with severe handicapping conditions. This guide is written for the person who does not have a technical background. All diagrams included are nonschematic and all procedures are described in nontechnical terms. In this age of rapid technical advancement, the contents of this guide are modestly simple, yet it is amazing how many benefits can be realized by the use of simple, inexpensive, common switches and electrical parts.

Good Luck !

M.F.G.

THIS BOOK IS DEDICATED TO ELAINE,

HOOKER, JOEY,

KEVIN, LEYLA, STEVEN, TOM, & VIRGINIA

*Note: All electronic and electrical components referred to in this book were purchased at Radio Shack Electronic Stores and Electrical Supply Outlets.

PROJECT REACH

(Reconstructive Equipment Adaptations for Children with Handicaps)

Michael F. Giangreco, Ed.S.
Project Director

Sponsored by:
The Foundation for Exceptional Children, Reston, Virginia
&
T-S-T BOCES Special Education Training & Resource Center
Ithaca, New York

In July 1984 Project REACH was initiated through a year long minigrant awarded by the Foundation for Exceptional Children in honor of Bill Geer. The project was designed to serve children with physical and/or mental handicapping conditions, birth through age 21 in Tompkins, Seneca, Tioga, and Cayuga counties in Central New York State. Project REACH serves this population, their families, caregivers, teachers, and therapists by providing them with a variety of materials and information regarding the use of adapted microswitches and electrical devices. As stated in the grant's proposal:

"A portion of children with motor disabilities experience little appropriate control within their daily environments due to physical handicaps which interfere with their abilities to independently manipulate objects, communicate, be mobile, and engage in routine activities of daily living. Inexpensive, easy to build miniaturized switches and other common electrical equipment can be used to provide a measure of environmental control. Many children do not have access to such equipment because many parents, teachers, and therapists do not have access to the information, materials, and tools necessary to adapt switches, toys, and other devices for their children."

Project REACH Services Include:

1) A tool kit containing essentially all the tools necessary to assemble switches, adapt devices, etc. is available on loan from T-S-T BOCES SETRC.

2) Several example switches and adapted devices are available on loan from T-S-T BOCES SETRC.

3) Copies of this book detailing the assembly of switches, adaptation of devices, and other related information is available on loan through T-S-T SETRC in Ithaca, New York and several neighboring SETRC's.

4) Workshops pertaining to the Project's activities are available upon request. Workshops have been conducted in Ithaca, Owego, Syracuse, and Auburn, New York.

CHAPTER ONE

RATIONALES FOR THE USE OF ADAPTED SWITCHES AND DEVICES

RATIONALES FOR THE USE OF ADAPTED SWITCHES & DEVICES

When people see adapted switches and devices in operation, their first reaction is frequently one of amazement. The novelty of the devices seems to captivate people's interest. Herein lies a danger - such novelty occasionally prompts people to use the novel approach without closely scrutinizing its appropriateness for a given person. Adapted switches and devices are **not** the best alternative for all persons with severe handicapping conditions. Be cautious and avoid jumping on the "Adapted Bandwagon" unnecessarily. Here are some points to consider when trying to determine if an adapted switch is needed:

1) If the person can turn on and off devices already, they do not need a special switch.

2) Ask yourself if there is an easier, more normal way for the person to operate electrical devices. For example:
   a) Maybe the person can only use one hand and they need two, one to stabilize the toy/device and one to turn on the switch. Rather than making an adapted switch, the device could be stabilized, allowing the person to use their functioning hand to turn on the toy/device.

   b) Maybe the person can not turn on the device because the switch is too small. In some cases merely making the switch bigger, such as by adding an extention to it, may allow a person to activate it.

   c) Some individuals who function in the severe or profound ranges of mental retardation and who are not physically handicapped may not turn on switches because they have not learned how to do so. Rather than adapting the switch, it may be more appropriate to concentrate your efforts on directly instructing this person in how to operate the existing switch without adaptation.

3) The following are some characteristics occuring in isolation or combination which <u>may</u> indicate the use of an adapted switch:
   a) limited or nonexistent finger use
   b) limited hand or arm use
   c) hypotonicity (low muscle tone)
   d) hypertonicity (high muscle tone)
   e) athetosis (fluctuating muscle tone)
   f) ataxia (coordination difficulties)
   g) limited range of motion
   h) low rate of movement responses
   i) limited head control
   j) limited trunk control
   k) congenital or traumatic abnormalities of limbs
   l) abnormal primitive reflexes
   m) lack of a consistent, discrete response mode

<u>NOTE:</u> *It is important to remember that to maximize the potential benefits,*

adapting a switch and device must be done in conjunction with proper seating and positioning, use of functional, motivating equipment, and direct, systematic instruction.

RATIONALES FOR ASSEMBLING SWITCHES AND DEVICES

ENVIRONMENTAL CONTROL: A portion of persons with motor disabilities experience little appropriate control within their daily environments due to physical handicaps which interfere with their abilities to independently manipulate objects, play, communicate, be mobile, and engage in routine activities of daily living. Some individuals respond to this lack of control by engaging in unmotivated, dependent behavior. Others may become extremely frustrated or bored by this lack of control. At times this may be manifested as self-stimulation, self-abuse, or socially undesirable behavior directed toward other people or property. Most of us can only imagine what it might be like to be without the most basic control which we often take for granted. Adapted switches and devices provide one outlet for a person with a severe handicap to appropriately control his/her immediate environment in an active fashion.

DEVELOPMENT OF A RESPONSE MODE: A frequent problem encountered by persons working with individuals who have severe handicaps is that some of those individuals have no consistent response mode (method of acting on the environment). If a person points to indicate what they want, pointing is his/her response mode. Speaking, vocalizing, pointing, eye blinking, signing, puffing air, foot or hand tapping, gesturing, eye gaze, and facial expressions are some examples of potential response modes. If an individual has motor limitations to the extent that they are unable to consistently perform any discretely distinguishable motor response for others to interpret, then the use of an adapted switch may build upon existing behaviors by improving them and/or by making them appear more discrete. Development of a discrete, socially acceptable response mode can lead to higher level learning and is an important first step toward more effective communication.

PARTIAL PARTICIPATION: As described by Baumgart, Brown, Pumpian, Nisbet, Ford, Sweet, Messina, & Schroeder (1982), the principle of partial participation advances the notion that persons with severe handicaps

should be allowed and encouraged to participate in whatever portion of an activity they can, despite their possible inability to engage in the entire activity independently. Adapted switches and devices provide a practical example of partial participation in practice

FUNCTIONAL ALTERNATIVES: Williams & Fox (1980), described the concept of functional alternatives. This refers to alternative methods of achieving a desired function. For example, when assessing the skills of a young child developmentally, we often observe his/her ability to walk. Walking is the expected mode of mobility. Examined from a broader view, it is not the act of walking that is most important, but rather the function of mobility. If the child can not walk, but can operate a wheelchair, then that child is mobile by means of a functional alternative. Communication boards and sign language are examples of functional alternatives to speech which achieve the function of communication. Adapted switches and devices are viable functional alternatives to achieve a wide variety of functions such as toy play, engaging in independent leisure activities, communication, mobility, engaging in daily living skills, and vocational tasks.

MULTIPLICITY OF PURPOSE: Teaching functional tasks which overlap needs of the learner is a strategy that becomes increasingly useful for learners whose abilities are severely delayed. The lower the functioning level of the learner, the greater the need for multiplicity of purpose in teaching programs (Giangreco, 1982). Due to the increased time and trials necessary for learning, the problems remembering and recouping learned skills (Brown, Nisbet, Ford, Sweet, Shiraga, York, & Loomis, 1983), and difficulties generalizing or applying what has been learned in different situations (Stokes & Baer, 1977), the use of adapted switches and devices serves to operationalize the notion called multiplicity of purpose. Since homemade switches and devices can be designed to be interchangeable, learning to activate a single switch may provide access to a multitude of varying outcomes. The multiple use nature of the adapted switch makes it an important skill with far reaching implications.

MOTIVATION: Adapted switches and the devices that they interface with (connect to) may be used as a motivational strategy. The novelty of the devices and the interesting consequences they produce are often capable of attracting previously elusive or inconsistent attention to a task. This may also assist in determing preferences and potential reinforcers.

JUSTIFICATION FOR MORE SOPHISTICATED EQUIPMENT: At times our enthusiasm for assisting a person with a handicap leads us to pursue equipment which is more sophisticated than we need. The use of simple, inexpensive, homemade switches and adapted devices can provide a great deal of useful information as we search to find the most appropriate equipment for the learner. Funding sources should be more likely to approve increasingly expensive budget requests if the learner has demonstrated the skills necessary to use more elaborate equipment. If the learner is unsuccessful, you may save a lot of money. For a few dollars you can do extensive experimenting and rearranging with readily available parts and equipment.

ENCOURAGING COGNITIVE DEVELOPMENT: Adapted switches can be used to encourage early cognitive development. Adapted switches and devices offer precise, contingent consequences for responding. This exactness may allow for the development of early causal relationships. These early concepts are important in developing higher level cognitive and communicative behaviors. More sophisticated forms of adapted switches and devices such as automated teaching machines and computers are being used to teach a wide range of concepts and skills. While the use of computers and other more sophisticated equipment is beyond the scope of this book, it is important to remember that the acquisition of one response, such as turning on a switch, can open many doors including to some computer programs.

ENCOURAGING MOTOR DEVELOPMENT: As stated earlier, the information included in this book is designed primarily to address the needs of children with severe motor limitations which interfere with their abilities to actively participate, at least partially, in a wide variety of daily living activities. Adapted switches may be used as a motivational technique to encourage specific motor behaviors. For example, mercury

switches are often used to facilitate improved head control. Subsequently, improved head control may potentially impact many other aspects of the child's life such as decreased drooling, improved eating, posture, and social interactiveness. It is crucial that the behavior being taught have some functional value. A switch that is activated by a grasp and release may assist in developing a skill that may have later usefulness in a variety of settings where a person uses grasp and/or release to hold a spoon, grasp a toy, squeeze toothpaste, or drop a coin into a vending machine. Switches can be individually designed and mounted to encourage movements from any part of the body. Head lifting, head turning, rolling, hands to midline, leg movements, and almost anything else you can imagine can be devised. Unless you are developing a consistent response mode, be careful not to spend time teaching motor skills which have no direct application to the person's daily life. Teach those movements which will offer the person the most additional or improved control within his/her environment.

ENCOURAGING SOCIAL SKILLS: Learners with severe handicaps frequently find themselves separated from individuals who are nonhandicapped even when they are physically in the same location. The writer contends that this may happen because the person with the severe handicap engages in few, if any, activities which would provide common ground for them to interact with nonhandicapped individuals of a similar chronological age. By providing access to a wide variety of chronologically age-appropriate battery-operated and electrical devices, adapted switches can help bridge the gap by offering activities of common interest.

ENCOURAGING DOMESTIC/LEISURE/ COMMUNITY & VOCATIONAL SKILLS: Adapted switches and devices can be applied to a variety of life-space domains. In the domestic area adapted switches can operate can openers, toasters, blenders, small microwave ovens, mixers, food processors, etc. In the leisure area they can activate devices such as radios, tape players, electronic games, model train sets, and a variety of toys. In the community switches can be used to activate communication devices to assist in purchasing goods and services, greeting people, answering questions, and making requests. Switches and adapted devices used in the community must be designed especially for portability and social acceptability. In vocational settings adapted switches and devices may

provide a method for some individuals to engage in meaningful work that otherwise may have been impossible.

REFERENCES

Baumgart, D., Brown, L., Pumpian, I., Nisbet, J., Ford, A., Sweet, M., Messina, R., & Shroeder, J. (1982). Principle of partial participation and individualized adaptations in educational programs for severely handicapped students. ***The Journal of the Association for the Severely Handicapped, 7,*** 17-27.

Brown, L., Nisbet, J., Ford, A., Sweet, M., Shiraga, B., York, J., & Loomis, R. (1983). The critical need for nonschool instruction in educational programs for severely handicapped students. ***The Journal of the Association for the Severely Handicapped, 8,*** 71-77.

Giangreco, M.F. (1982). Teaching imitation to a profoundly delayed learner through functional tasks. ***Education and Training of the Mentally Retarded, 17,*** 163-167.

Stokes, T.F. & Baer, D.M. (1977). An implicit technology of generalization. ***Journal of Applied Behavior Analysis, 10,*** 349-367.

Williams, W. & Fox, T. (1980). **Minimum Objectives System for Pupils with Severe Handicaps (4 Volumes).** Monograph Series. Burlington, Vermont: Center for Developmental Disabilities.

CHAPTER TWO

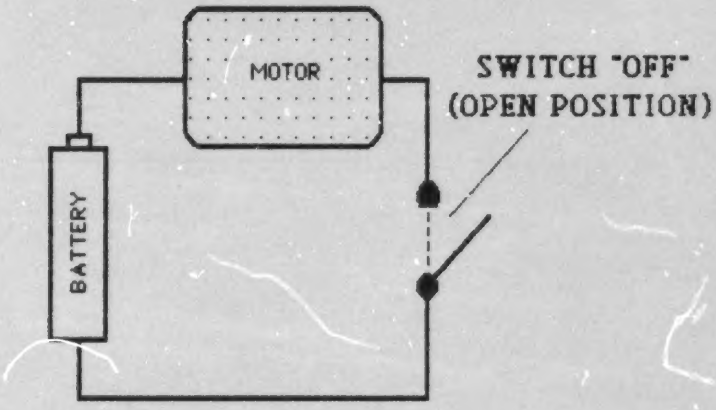
ASSEMBLING REMOTE CONTROL SWITCHES

ASSEMBLING REMOTE CONTROL SWITCHES

Understanding the Simple Circuit

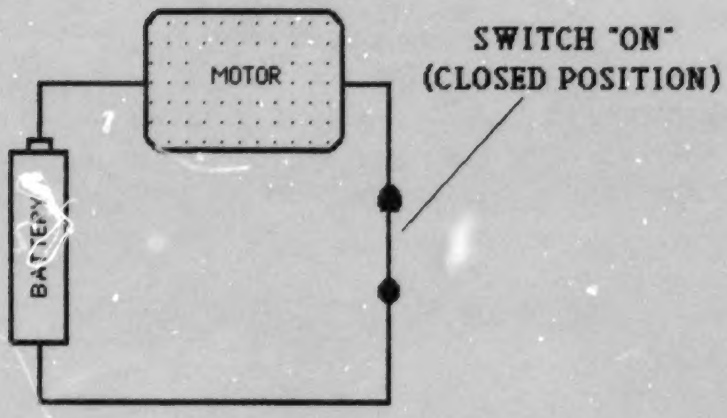
It is true that you can follow step by step instructions in "how to" manuals and successfully assemble any variety of projects, including switches and adapted devices. The problem is that devices to be adapted vary widely. That is why it is important that you understand why and how these switches and adapted devices work.

Simple Unadapted Circuit (Open)

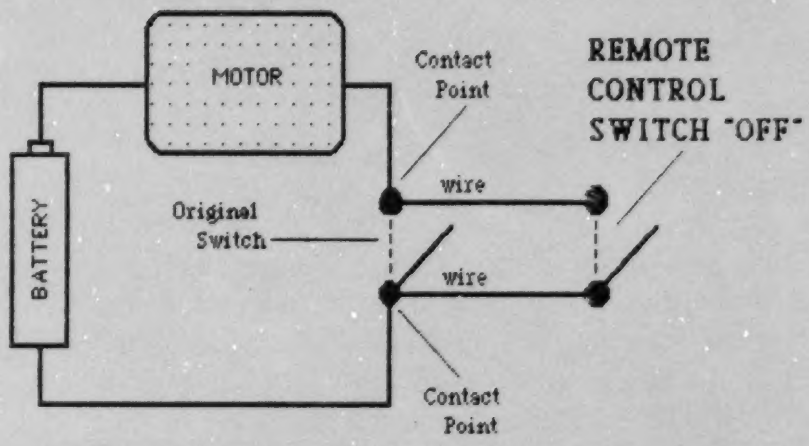


A simple circuit typically includes a power source (in this case a battery), a motor, light, or some other device which the power source activates, and a switch which allows one to turn the device on and off. Since the circuit requires an uninterrupted path between the power source and the device to be activated, the switch simply provides a mechanism to either make an opening or a closure in the circuit. As shown above, the switch is in the open position. Since this interrupts the circuit the motor will stay "off". As depicted in the following example, when the switch is turned "on" it completes the circuit and allows the motor to operate.

Simple Unadapted Circuit (Closed)

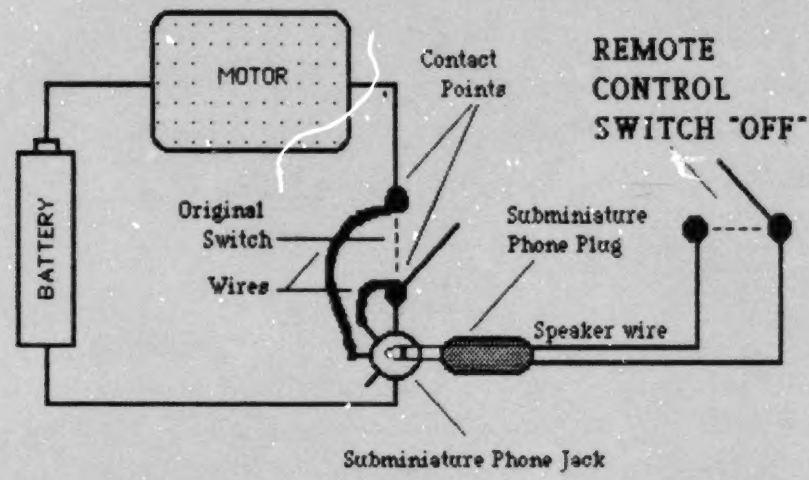


Simple Open Extended Circuit (Nondetachable)



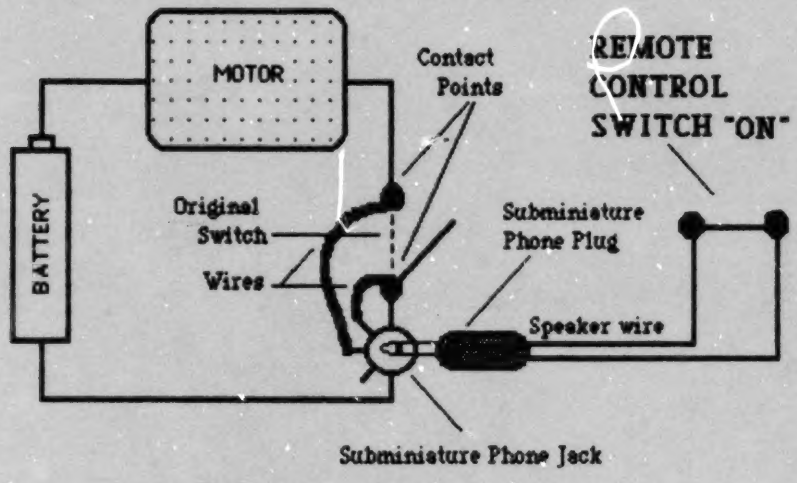
When we adapt a device and switch, all we are really doing is extending the circuit and attaching it to a different switch which is easier for the user to operate.

Simple Open Extended Circuit (Detachable/Interchangeable)



Since it is desirable to be able to interchange switches and devices, a subminiature phone jack can be installed in the device. The phone jack is connected to both sides of the break in the circuit by wires, thus making it serve the same purpose as the original circuit break, to interrupt the flow of electricity. You can not plug a switch into the original circuit break so you install the subminiature phone jack. The subminiature phone jack interfaces (connects) with the subminiature phone plug, effectively continuing the circuit break and extending the circuit out to the new adapted switch. Now when the new adapted switch is activated it completes or closes the extended circuit, allowing the electricity to flow in an uninterrupted fashion. Refer to the following diagram.

Simple Closed Extended Circuit (Detachable/Interchangeable)



If you understand this idea of extending the circuit , you will be able to apply it to the wide variety of set-ups you will find when you attempt to adapt switches and devices.

TYPES OF SWITCHES

There are a wide variety of switches that may be used in an adapted fashion. This guide will focus on the characteristics, assembly, and uses of three common switches which offer a wide range of versatility. These switches include the **lever switch**, the **mercury switch**, and the **push on/push off switch.** All three switches range in capacity from 3 to 5 amps. For information regarding other and more sophisticated switches refer to Holt, Buelow, & Vanderheiden (1978), Silverman (1980), Prentke-Romich (1984), and Campbell, McInerney, & Middleton (1982).

ASSEMBLY OF SWITCHES WITH AN INTERFACE PLUG COMPONENT

Tools: The following tools are necessary to assemble the switches described in this guide: wire cutter/stripper, knife or single-edged razor

blade, soldering iron, needlenose pliers, and a device to hold the parts still while soldering, this may range from a small hobby or jeweler's vice to a clothespin stuck in clay.

Soldering: Soldering is a skill that is used frequently when adapting switches and devices. In order to ensure a good electrical contact, the soldering must be done properly. If you have never soldered, find someone who knows how and ask them for some basic instruction and tips. In general it is important to preheat the area to be soldered. Apply conservative amounts of solder, you can always add more if it is needed. When applying the solder, maintain the soldering iron in contact with the area being soldered. The desired effect is for the solder to flatten out and flow freely on the heated surface. Clumps of solder are undesirable. Some metal surfaces in devices to be adapted will not readily accept solder , making the surface more rough with sandpaper usually helps. **Surfaces to be soldered must be clean.**

Materials: 6 to 10 feet of 22 gauge speaker wire, rosin core electronic solder, heat shrink tubing, subminiature phone plug, and a switch.

STEPS FOR ASSEMBLY OF AN INTERFACE PLUG COMPONENT

No matter which switch you decide to use, it will be desirable to attach a subminiature phone plug to one end of the speaker wire, the other end connecting to the switch. Subminiature parts have been selected because manufacturers of battery-operated devices did not design their equipment for potential adaptation, therefore some devices leave only tiny spaces for potential changes. If a subminiature phone plug is used, then a subminiature phone jack must be used so that they fit together properly. One could use plugs and jacks of other sizes as long as they are the same size and type. Many commercially available adapted devices and switches employ miniature sized parts rather than the subminiature components described in this guide. If you decide to use the subminiature size, you can still access devices and switches using other sizes of plugs and jacks via the use of inexpensive "adapters".

USING HEAT SHRINK TUBING

Throughout this guide references will be made to the use of heat shrink tubing. This material is a thin, flexible plastic tubing which is available in a variety of sizes by diameter. It is used to provide electrical insulation at solder joints. Heat shrink tubing is preferable to electrical tape because it can not become unwound. The tubing shrinks to a snug fit around wires when brought in contact with heat. The following steps should be carried out when using heat shrink tubing:

1) Select a size of heat shrink tubing which is slightly larger than the wires it will insulate.

2) The heat shrink tubing must be slid over the wire <u>before</u> it is soldered.

3) Push the tubing away from the site of the solder joint enough to ensure that the heat from the soldering iron does not activate the shrink characteristic of the material.

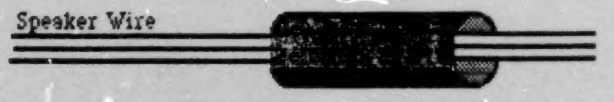
4) After the connection has been soldered and is cool to the touch, push the heat shrink tubing over the solder joint.

5) Using a match held near the tubing, shrink it thoroughly and evenly by turning the materials. Prolonged exposure to a direct flame or excessive heat will damage the heat shrink tubing. Whenever you use a flame of any sort, be sure to account for basic safety concerns such as the availability of a fire extinguisher, the absence of flammable materials in the vicinity, etc.

REFER TO THE AFOREMENTIONED GENERAL INSTRUCTIONS WHENEVER THE DIRECTIONS SAY "USE HEAT SHRINK TUBING"

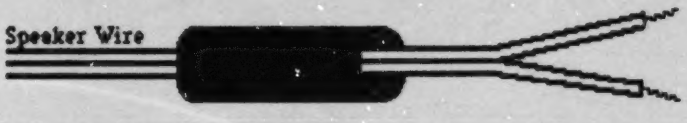
<u>The process is as follows:</u>

1) Unscrew the plastic casing from the subminiature phone plug and slide it over the speaker wire with the large opening facing the end where the plug will be attached:

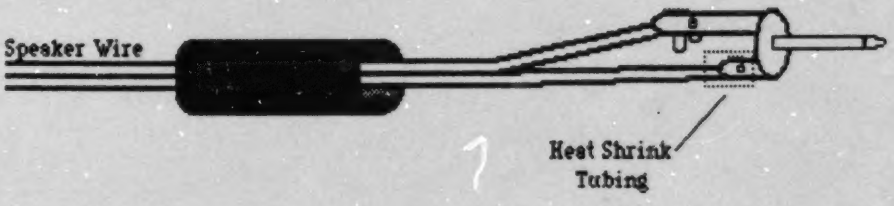


2) Separate the double wire by making a 1/2 inch cut down the center and pulling it apart an additional 2 inches;

3) Strip approximately 1/8 inch of the plastic coating off the end of each wire. After the coating has been removed, slightly twist the strands of wire on each of the two leads;



4) Attach the two terminals to the metal part of the plug. Attach one wire to each of the two terminals. Use heat shrink tubing over the solder joint attaching to the shorter of the two terminals. Clamp the wire down on the longer of the two terminals which has two small clamps affixed to it. This can be accomplished using the needlenose pliers;



5) Stabilize the plug and solder the wires to the terminals through which they pass. Use the solder sparingly so that the plastic casing will screw back on to the metal part of the plug;

6) Once the solder joints have been checked and are secure, double check to make sure that the two wires are not touching each other, they should be insulated from each other;

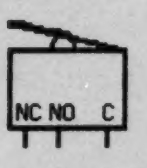
7) Go to the opposite end of wire and repeat Steps 2 and 3, but leave a 1/4 inch of exposed wire rather than an 1/8 inch. Follow the subsequent procedures to attach the various types of switches to the end of the wire opposite the interface plug component.

LEVER SWITCH

The lever switch is one of the most common switches used for adapted purposes. This switch is activated by slight pressure. The lever switch is dependable and durable while costing approximately $1.30 each. In order to maximize the usefulness of the lever switch is must be mounted individually for a specific person. Considerations for mounting switches is discussed in Chapter Three of this guide.

The lever switch looks like this:

NC = normally closed
NO = normally open
C = common



Note: Lever switches are available with small rollers attached to the top of the lever for increased ease of operation.

Option 1 (Single Switch Normally Open)

If you want the switch to work by depressing the lever, then solder one wire to the C terminal and one to the NO terminal. It does not matter which wire is attached to which terminal. Use heat shrink tubing.

In this option the switch will only be "on" as long as the lever is depressed. As soon as you release it, the switch will return to an "off" position by means of spring inside of the switch.

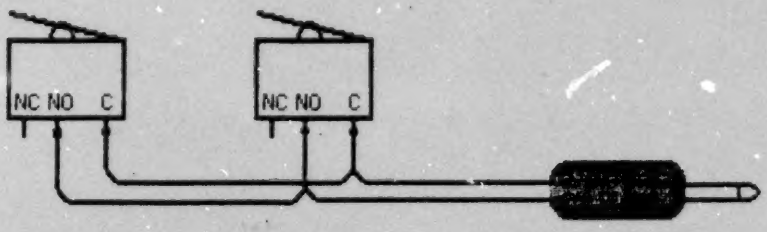
Option II (Single Switch Normally Closed)

By soldering one wire to the NC terminal on the lever switch and the other to the C terminal, the switch will be in the normally closed position. This means that when plugged into an adapted device it will be "on" continuously. By depressing the lever you will interrupt the circuit and turn the device "off". Insulate the terminals using heat shrink tubing.

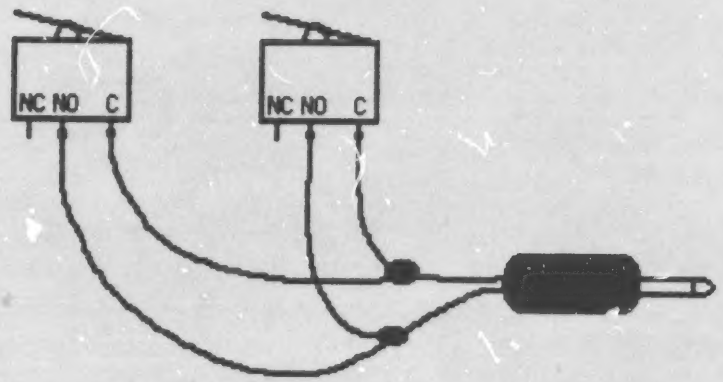
Option III (Multiple Lever Switches Wired in Parallel-Normally Open)

This option is typically used to increase the sensitivity of a mounted switch. For example, using Option I (single switch), certain sections of a potential pressure surface will be more sensitive than other areas due to the positioning of the switch under the surface. Wiring more than one switch together in parallel can improve the sensitivity of the switch by distributing activation points. Wire this option by first following the directions for Option I, then run a wire from the NO terminal on the wired switch to the NO terminals on other switches (as many as are to be used). Repeat the same process with the C terminals by connecting them together and soldering them all in place. Use heat shrink tubing to insulate the terminals and solder joints. In the following examples the device that the switch is plugged into will work if ***any*** of the switches are activated.

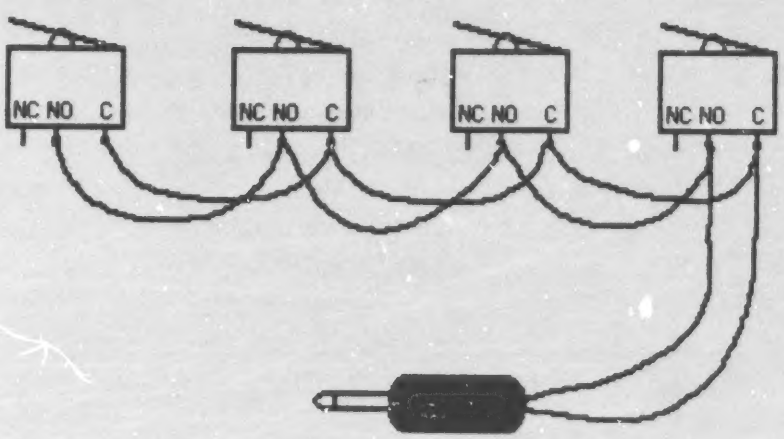
Two Lever Switches in Parallel(Normally Open)



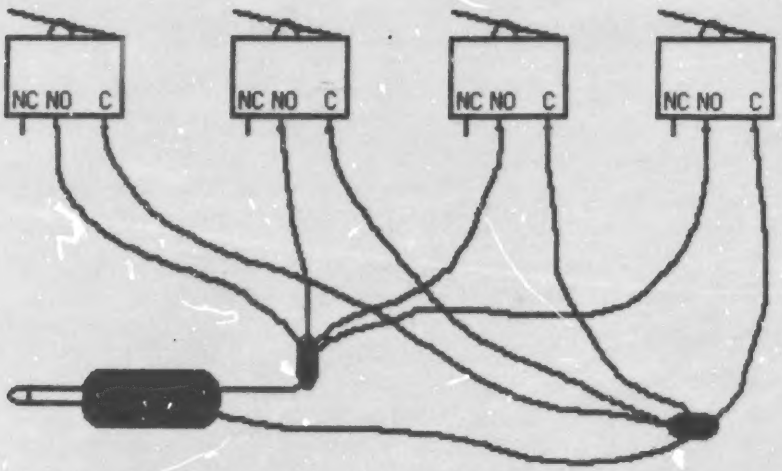
OR



Multiple Lever Switches in Parallel (Normally Open)

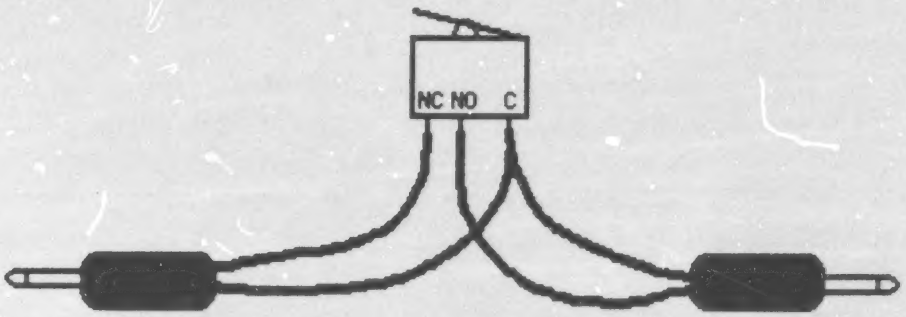


OR

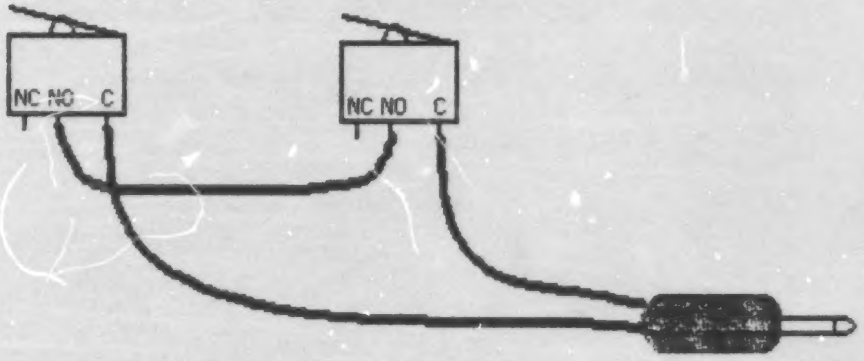


Option IV Single Lever Switch Wired Both NO and NC

In this option one switch with two plugs is wired so it can operate two adapted devices in an alternating fashion. Given the nature of the switch, one of the two devices would always be "ON". This is accomplished by first wiring two plugs separately as described in "Steps for Assembly of an Interface Plug Component". After the two plugs have been properly wired, solder one wire from each of the two plugs to the C (common) terminal on the switch, use heat shrink tubing. Then solder the remaining wire from one plug to the NO terminal and the remaining wire to the NC terminal, use heat shrink tubing.



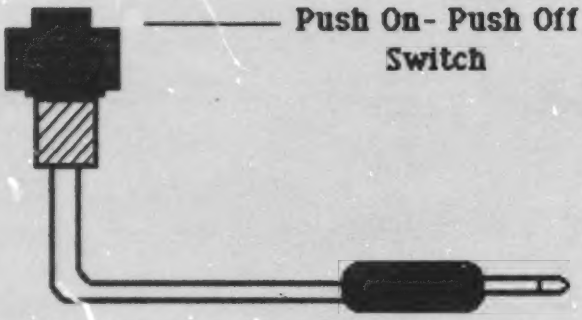
Option V Two Lever Switches Wired in Series (Normally Open)



This option requires both of the switches to be activated simultaneously in order to activate an interfaced device. Use heat shrink tubing.

PUSH ON - PUSH OFF SWITCH (SPST SOFT FEEL)

The "Push On - Push Off" switch is activated by pressure, but is less sensitive than the lever switch described earlier and has different characteristics. Unlike the lever switch which remains "On" only as long as pressure is maintained, the "Push On - Push Off" switch remains "On" following one push and release. This switch will remain "On" even if pressure to its surface is interrupted. To turn it "Off", the same push/release sequence must be repeated. An advantage to this type of switch is that it can be used with certain types of devices/appliances which do not respond well to intermittent interruption of power. For example, interruption of power to a record player will ruin records. Using the "Push On - Push Off" switch, a person may turn on the record player and then the switch may be removed until it is time for the person to reactivate the switch in order to turn it off. This switch is assembled by simply soldering one end of the speaker wire to a plug as described earlier in "Steps for Assembly of an Interface Plug Component" and soldering the wires at the other end of the speaker wire to the terminals on the switch as depicted in the following diagram. Use heat shrink tubing. This switch costs approximately $1.30.



MERCURY SWITCH (Bulb Type)

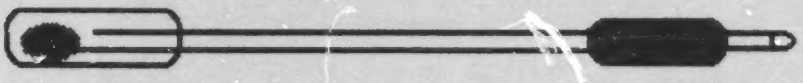
A mercury switch is activated by position or tilt. Its most common nonadapted use is as an "On/Off" switch in thermostats which control furnaces. Mercury switches are frequently used in adapted situations to promote postural changes, such as encouraging improved head control or as a sensitive method of activation accomplished by slight movement. For example, a person with advanced stages of psuedohypertrophic muscular dystrophy may only be able to control slight finger movements. A mercury switch attached to a ring on a finger could allow this person to operate a variety of devices. Mercury switches may be purchased for approximately $1.20.

Option I - Single Mercury Switch

In this option the mercury switch will be "On" only if the mercury inside of the switch is in contact with both terminals of the switch simultaneously. To assemble, attach one wire to each of the two terminals of the switch. Solder the connections, making sure that the two wires do not touch each other. Use heat shrink tubing. Attach a plug at the opposite end of the speaker wires following the directions listed for "Steps for Assembly of an Interface Plug Component".

"On" (mercury touching both terminals)

"Off" (mercury touching only one terminal)



Option II - Double Mercury Switch (Wired in Series)

Since the mercury switch is frequently used in programs related to postural feedback, the single mercury switch option may not be optimal. For example, using a single mercury switch set-up to encourage head lifting, the switch is "Off" when the person's head is dropped forward; when she raises her head the switch is "On". The problem arises if the person drops her head too far backward into a poor posture. In this case the single mercury set-up would keep the switch "On" despite the undesirable posture. To avoid this problem mercury switches can be wired in "series" so that the device being used will be "On" only when all of the switches are in the "On" position. This allows the designer to create a range of what is desirable.

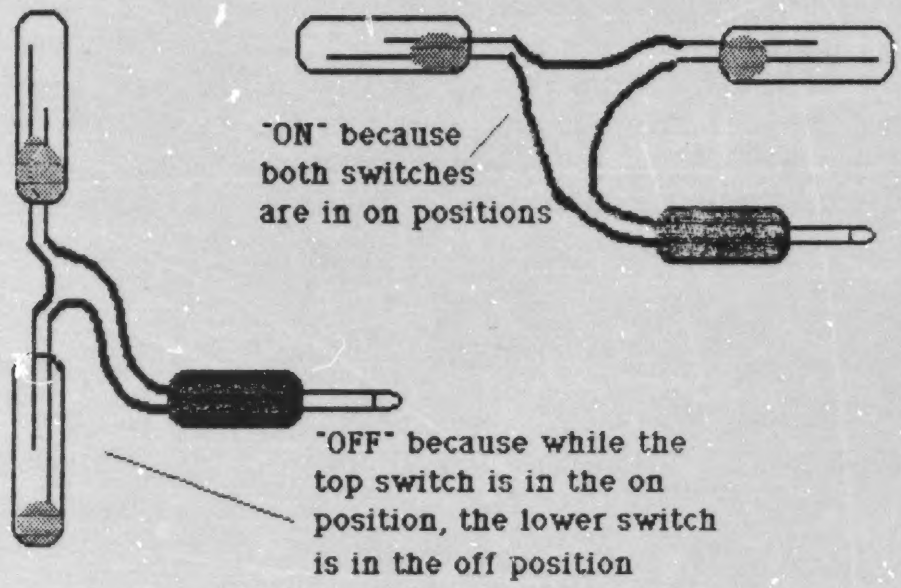
Using the same general techniques described previously, mercury switches can be wired in series by following these steps:

1) Mount a plug on one end of the speaker wire (refer to "Steps for Assembly of an Interface Plug Component");

2) At the other end of the speaker wire, solder one wire to either terminal of one switch. Use heat shrink tubing.

3) Solder the remaining wire to either terminal of a second switch. Use heat shrink tubing.

4) Solder another single piece of wire connecting the two remaining terminals. The length of this connecting wire will vary depending upon how the switches will be mounted for use. Use heat shrink tubing.

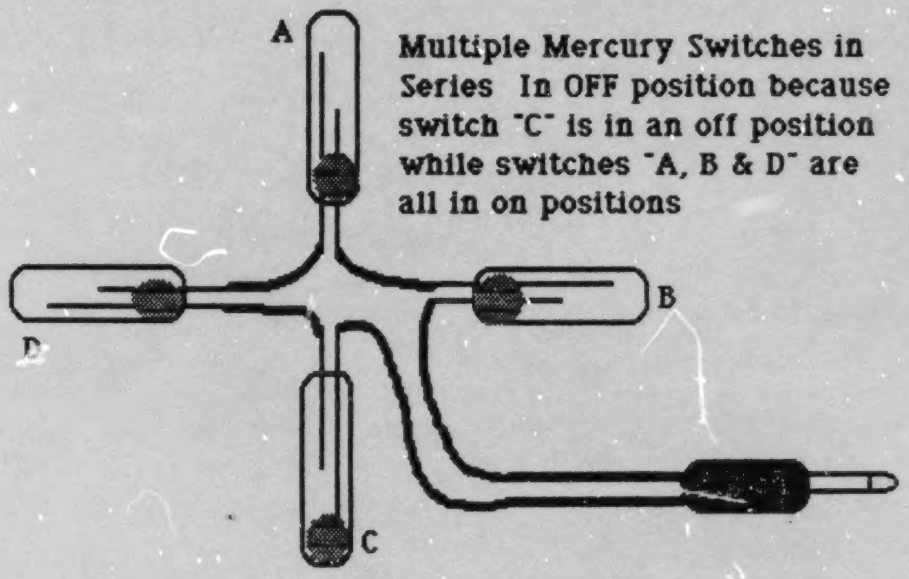

"ON" because both switches are in on positions
"OFF" because while the top switch is in the on position, the lower switch is in the off position

Option III - Multiple Mercury Switches (Wired in Series)

The wiring of more than two mercury switches in series can add increased precision to the adapted device. Using the double mercury switch a person can account for only two directions. Using increasing numbers of mercury switches you can account for additional directions as needed.

The following wiring diagrams depict multiple mercury switches wired in series in both "On" and "Off" positions. A positive attribute of these types of switch arrangements is that each one of the mercury switches can be individually adjusted for activation given varying degrees of tilt. This allows for a great deal of flexibility and for shaping of responses to occur. Suggestions regarding the mounting of these switches are discussed in Chapter 3.

In order to assemble multiple mercury switches in series you would first attach a plug to one end of a length of speaker wire (Refer to Steps for Assembling an Interface Plug Component"). Then at the opposite end of the speaker wire solder one wire to one terminal on one of the switches and the remaining wire to one terminal on a second switch. Use heat shrink tubing. Then attach/solder a wire between each remaining terminal. Use heat shrink tubing. Remember that if one of the multiple switches is in the "Off" position the switch will not be activated. All of the switches must be in the "On" position in order for the switch to operate a device.

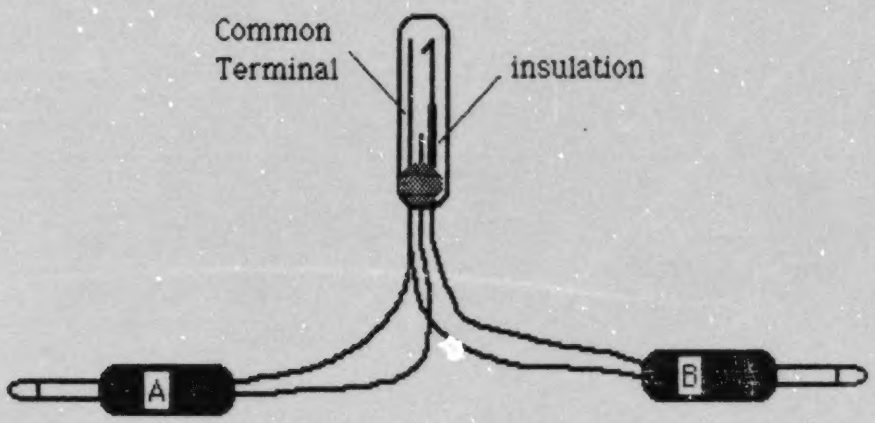


Multiple Mercury Switches in Series In OFF position because switch "C" is in an off position while switches "A, B & D" are all in on positions

Option IV - Three Terminal Mercury Switch Wired in Both Normally Open and Normally Closed Positions

This option is similar to Option IV for the lever switch. The single switch can operate two adapted devices in an alternating fashion. Given the nature of this switch, one of the two devices would always be "On". This option is assembled by, 1) first wiring two plugs separately to separate lengths of speaker wire as described in "Steps for Assembly of an Interface

Plug Component". 2) After the two plugs are properly wired, attach one wire from each of the two plugs to the common terminal (this terminal is identified by looking at the switch closely while tilting the mercury back and forth). The common terminal has no insulation on it and always maintains conductive contact with the mercury no matter what position it is in. Use heat shrink tubing. 3) Then solder the remaining wire from plug A to one of the remaining terminals on the switch, and the other wire from plug B to the other terminal on the switch. Use heat shrink tubing. Following completion of wiring the switches they must be mounted individually to account for specific characteristics of the user and the potential applications.



REFERENCES

Campbell, P.H., McInerney,W., & Middleton, M. (1982). **A manual of augmented sensory feedback devices for training severely handicapped students.** Akron, Ohio:Children's Hospital Medical Center of Akron.

Holt, C., Buelow, S., & Vanderheiden, G. (1978). Interface switch profile and annotated list of commercial switches. In G.C. Vanderheiden (Ed.) **Nonvocal communication resources book.** Baltimore, Maryland: Unviersity Park Press.

Prentke - Romich Catalog (1984). **Electronic aids for the severely handicapped.** c/o Prentke-Romich Company, R.D. 2 Box 191, Shreve, Ohio 44676.

Silverman, F.H. (1980). **Communication for the speechless.** Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

CHAPTER THREE

MOUNTING MINIATURE REMOTE CONTROL SWITCHES FOR USE BY PERSONS WITH HANDICAPPING CONDITIONS

MOUNTING MINIATURE REMOTE CONTROL SWITCHES FOR USE BY PERSONS WITH HANDICAPPING CONDITIONS

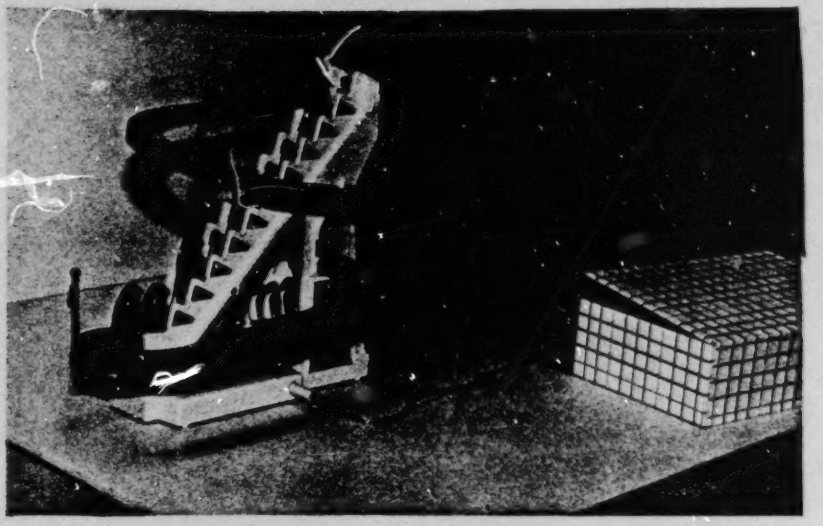
Once a switch has been properly wired (as discussed in the previous chapter), it is necessary to mount it for use. In this chapter we will discuss general considerations for mounting switches and provide specific examples of how switches may be mounted. Switches can be mounted in innumerable creative ways to individually account for characteristics of the user.

Surface Area/Size

One of the most basic mounting considerations is to examine the size of the surface area used to activate the switch. Microswitches are by definition, small. In order for these sensitive devices to be operated by a person with impaired motor abilities it is frequently necessary to mount the switch in such a way as to increase the surface area. It is important to make the size of the surface area only as large as needed, not any larger.

In Figure 1 a Push On - Push Off switch has been mounted inside of a cigar box which has been covered with plastic contact paper. By doing this you have increased the size of the activation area from less than one square inch to several square inches (the entire top of the cigar box).

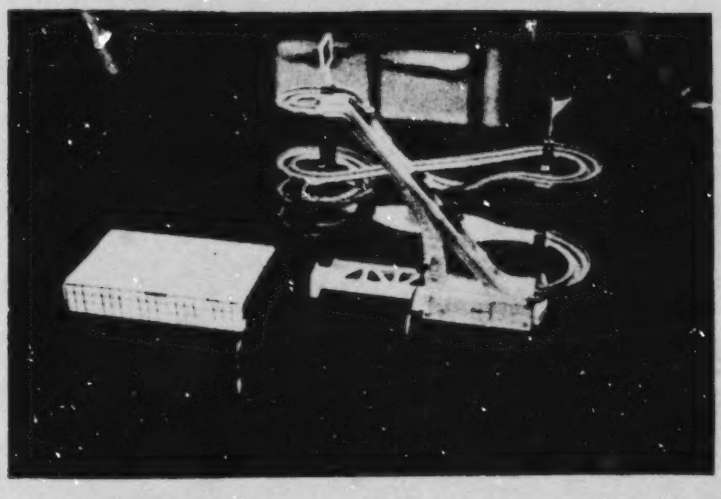
Figure 1



Portability

Portability is a crucial factor to consider since it is desirable for the user to have access to his/her switch in a variety of settings (home, school, community, & work). In Figure 2 the switch, which is mounted inside the box, is small enough that it easily could be carried from place to place. Large elaborate systems may interfere with use in community settings.

Figure 2



Durability

Construct mounting systems to be durable enough to withstand continuous and occasionally rough use. Cigar boxes make excellent mounting compartments for lever switches, and at times Push On - Push Off switches.

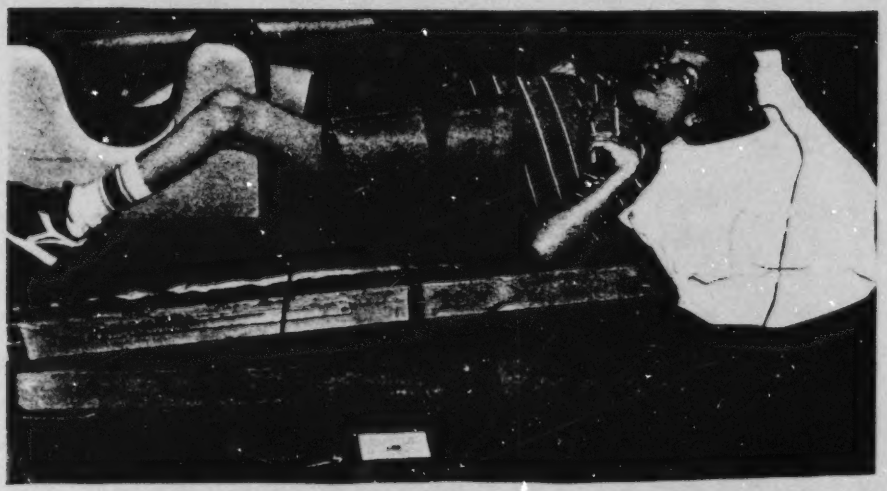
Age-Appropriateness

People in our society are frequently viewed by others based upon external characteristics. In this case, the physical characteristics of the switch mounting system can have a significant impact on how the user is perceived by others, and subsequently treated. Give the switch an appearance which matches the user's chronological age.

Learner Preferences and Characteristics

When selecting switches and devices it is important to consider both the user's preferences and characteristics. For example in Figures 3 and 4 this young man is activating a vibration pad which is positioned by his side. He activates a lever switch mounted inside a pillow by turning his head to his left. The pillow switch was used because this individual has no purposeful limb function. In these photos the vibration pad and the pillow switch are plugged into a Switch Interface Relay(SIR), which is described in Chapter 5. The SIR allows the young man to safely turn the electrically powered pad ON and OFF.

Figures 3 & 4



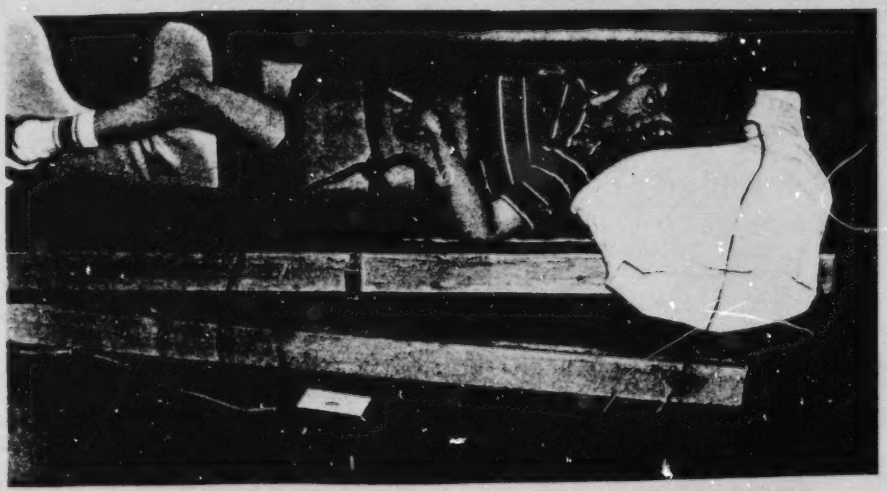
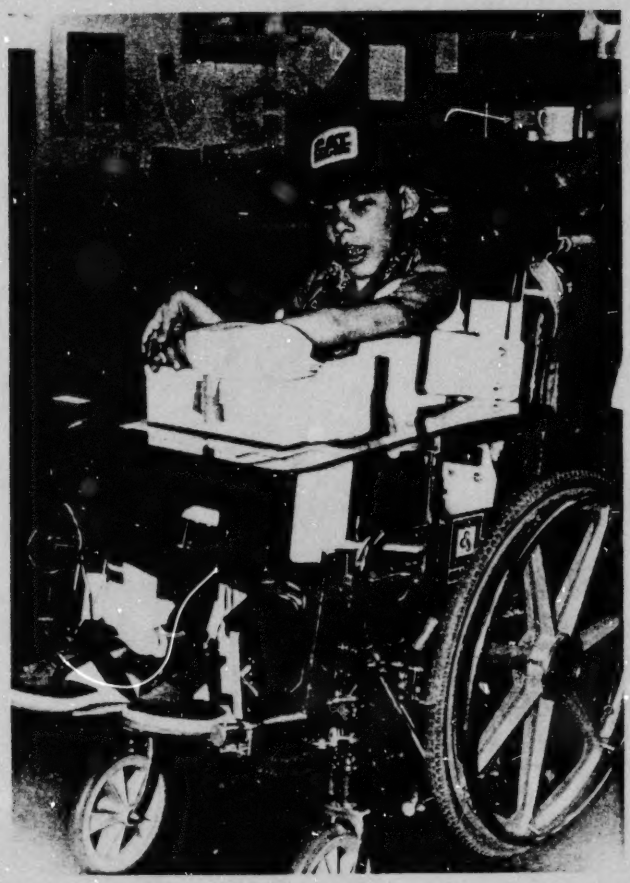


Figure 5 depicts a youngster with fluctuating muscle tone activating a dual switch system mounted inside of a cigar box . The switches are interfaced with two tape recorders. One tape recorder includes a tape loop which said "Yes" in a boy's voice, while the other said "No". The student used the system to respond to questions and to converse. The main feature of the mounting system which relates to the user's characteristics is the built-up solid foam block which separates the two switches in the system. The block assists the user in stabilizing his arm and prevents him from inadvertently turning on the neighboring switch. It is also worth noting that this individual is properly positioned in a custom-designed wheelchair insert. Proper positioning is crucial in order to pursue effective switch activation. If you suspect that the potential switch user is improperly positioned, consult someone with experience in this aspect of habilitation, such as an occupational or physical therapist.

Figure 5



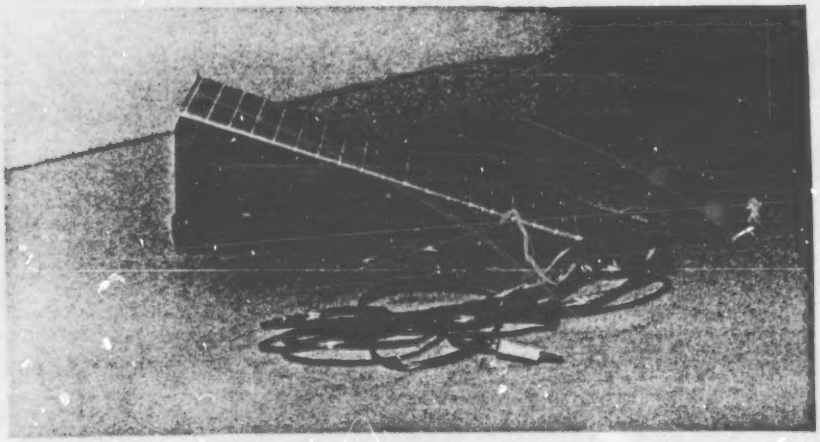
In Figure 6 the same student positioned in sidelying is using a more elaborate mounting system to activate a single lever switch. A drawback to this particular mounting system is its large cumbersome nature - this detracts from its portability and ultimately its usability in a variety of settings. Although it lacks portability, it still may be appropriate to construct such systems if they allow the user to continue participation in activities while positioned alternately for therapeutic reasons.

Figure 6

Planes of Contact/Control

To this point the mounting examples have all had one aspect in common, they were all activated by contact with a horizontal plane (the top of the box). Some switch users are unable to lift their hands/arms to reach the lid of the box in which the switch is contained. In such cases, varying degrees of horizontal tilt may be considered as well as the use of vertical planes of contact. Figure 7 shows a lever switch mounted on a modified horizontal plane. This switch is designed to be activated by either hand or foot contact. It can be turned on its side to create a vertical plane of contact if necessary.

Figure 7

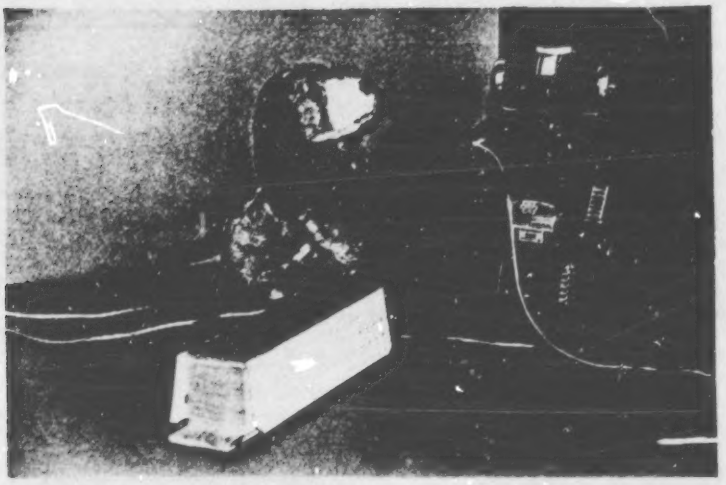


In Figure 8 a young woman turns on a portable fan by activating a lever switch mounted on a vertical plane.

Figure 8

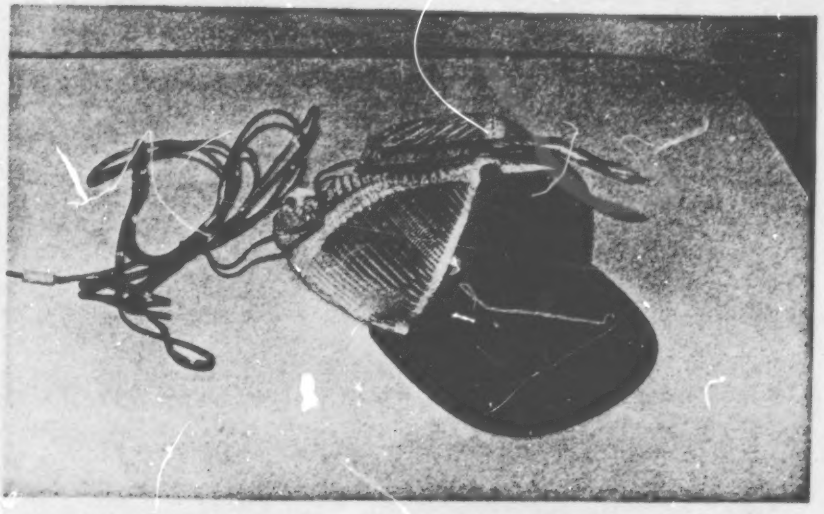
Figure 9 shows a mounting system which is a slight design variation of the previous example. The child for whom this switch was designed required less surface area and size to accomplish activation and subsequently used a smaller mounting system. This example also points out that two lever switches can be mounted in the same system, one on each side. This provides the user with a choice of toys with which to play.

Figure 9



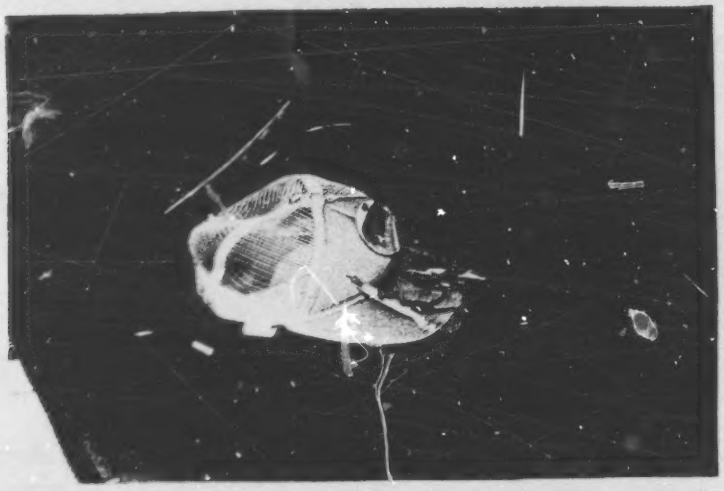
In reference to mercury switches, which are activated by tilt, we consider planes of control rather than contact. Figure 10 shows a mercury switch on top of a baseball cap.

Figure 10



The switch in Figure 10 has been mounted so that when the student's head is dropped forward it is in the OFF position, when the head is raised sufficiently the switch is turned ON. The number of degrees which the head needs to be raised to engage the switch can be changed since it is attached to the baseball cap using a flex-straw. This method allows for shaping increasingly higher head lifts. A major limitation to the use of a single mercury switch for the purposes described here is that a person's head moves along more than one plane. For example, using the single mercury switch the user could drop his/her head back too far into a hyperextended position and the switch would remain ON. This can be addressed by adding additional switches wired in series as shown in Figure 11.

Figure 11



This allows you to adjust the switches to establish an acceptable forward/backward range. To account for side to side head position additional mercury switches would have to be wired in series and mounted accordingly. A rationale for using a cap with a visor was not only its age-appropriateness, but also the fact that the visor shielded the user's view when his/her head was dropped too far forward. Some individuals with poor head control have little motivation to lift their head because they can see much of their surroundings without having to put all their effort into head lifting.

Stabilization

When designing your switch mounting system, consider how the switch will be stabilized or secured in place. Velcro, moistened suction cups, and C-clamps are three common methods of stabilization. Velcro is probably the most limiting because it is typically the weakest, requires permanent adhesion to the surface involved and limits flexible arrangements. Use of suction cups, such as those which may be purchased for under $1.00 (meant to be soap holders), must be moistened for maximum efficiency and require smooth,waterproof surfaces. Typically they are quite strong and allow for flexible arrangements. C-clamps which can be purchased at any hardware store are the strongest of the three options but do require preplanning in your mounting design and construction. An extension must be built onto the switch with a strong material such as wood. Figure 8 shows a switch stabilized by a C-clamp.

Sensitivity

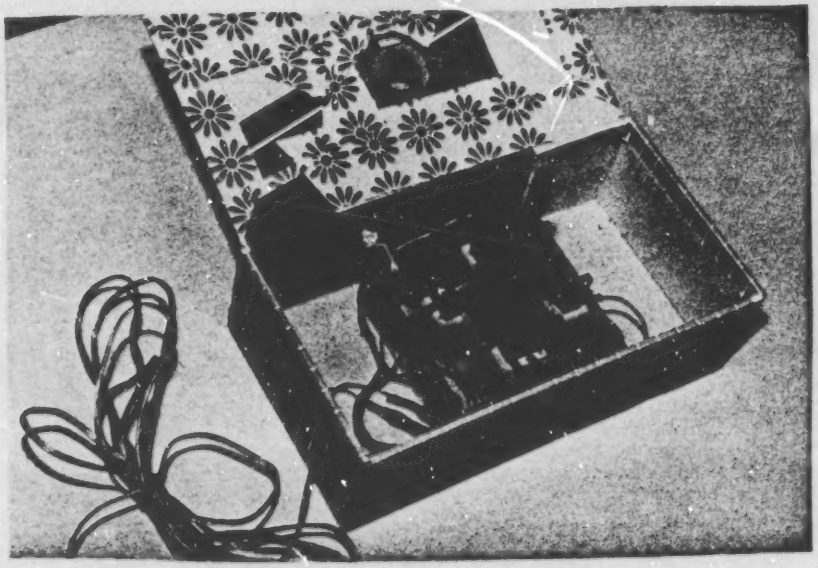
In many cases the use of a single lever switch provides sufficient sensitivity to allow for easy activation. Occasionally individuals with extremely limited motor skills or strength may require switch systems with greater sensitivity. Typically this can be accomplished by wiring a few switches together in parallel and/or by altering the mounting design.

In Figure 12, four lever switches were wired in parallel and mounted inside of a box. A switch was positioned in the center of each side wall as noted by the four squares on the lid. The lid which is normally hinged was detached and a center post was secured in the middle of the box. Two small strips of cloth were added to the two shorter sides of the box to keep the lid from being opened. These alterations increased the switch's sensitivity. This system is also useful for individuals who are more interested in opening the lid of the box than pressing it. Using this system, when the user attempts to open the lid it activates the switch in the back of the box. It is hoped that eventually the user will learn the relationship between the switch and the device to which it is attached.

Figure 12

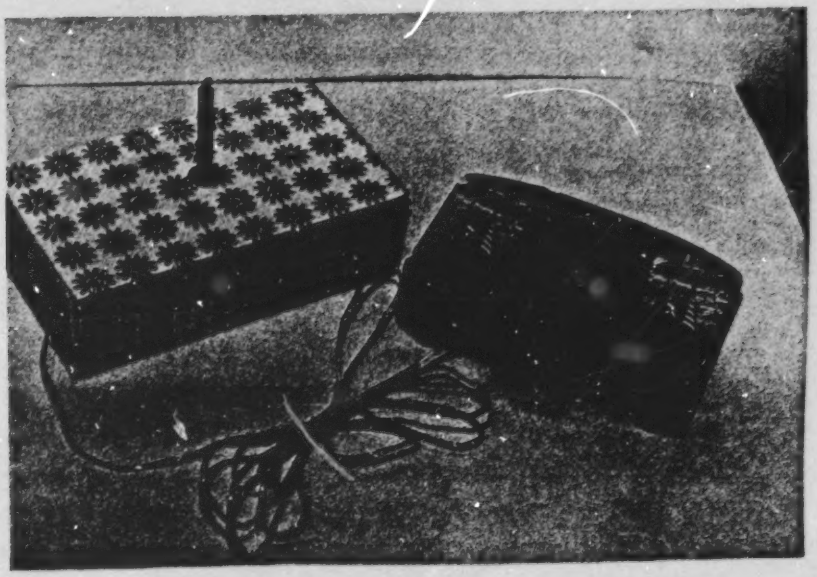
Another mounting system variation which increases sensitivity is displayed in Figures 13 &14. In this system the four switches are wired in parallel as in the previous example but are mounted differently. As shown in Figure 13, the switches are attached to a square piece of wood with a square opening in the middle. The opening contains a spring through the center of a 35mm film canister. Underneath the canister, the spring is surrounded by foam rubber which keeps it in an upright position and always returns it to that postion following activation and release.

Figure 13



When this system is set up for use as shown in Figure 14, the spring protrudes through a hole in the top of the box. Any slight contact to the spring in any direction will activate the device to which the switch is attached, in this case an automatic card shuffler. This type of arrangement is especially useful for a person with a low frequency of movement response. The person's hand can be rested on top of the box close to the spring - this allows for activation with minimal effort.

Figure 14



Recoil

Lever switches and Push On-Push Off switches have internal spring mechanisms. When mounted inside a box or other system the weight of the lid may be too heavy for the internal spring to accomodate. The result is that the switch will not turn off when contact with the activation surface is discontinued. To assist the internal spring, external springs may be employed. Foam rubber pieces are a durable, inexpensive solution to this problem. Since it is nearly impossible to cut the foam rubber to exactly the perfect size, it is recommended that you cut the piece of foam rubber slightly small. You can adjust it in an extremely refined fashion by putting small portions of cotton balls atop the foam rubber piece until it provides the desired level of resistance and recoil.

Safety

Check the mounting system for safety. Look for pointed edges near the eyes and mouth, check the location of the cord. Safety issues vary by individual depending upon the user's characteristics. Insulate all exposed wires and metal contacts. Use of battery-operated devices and switches described in this book are extremely safe due to their use of very low levels of DC electricity and levels of resistance. The Switch Interface Relay (SIR) described in Chapter 5 is a safety device designed to allow users to access electrical equipment which is powered by AC electricity from wall outlets. Since the SIR is designed to protect the user from higher levels of electricity, it is especially important to make sure that it and the switches interfaced with it are adequately insulated.

Texture

Typically texture is not a crucial consideration in developing mounting systems for switches. Texture should be examined if the user has a history of tactile defensiveness or is observed avoiding the texture of a currently used activation surface. In general the texture of the surface contact areas should be perceived as at least neutral by the user.

Cleanability

Like any tool which is used frequently, the switch mounting system will need to be cleaned. Covering surfaces with smooth vinyl contact paper is an inexpensive way to address this issue. Also, the use of smooth contact paper will allow for the use of suction cups as a method of stabilization.

Novelty

When introducing a switch and a toy to a young child, it is not uncommon for the child to reach to the toy directly rather than reach to the switch. At times when this happens we might change the arrangement or type of switch or alter the instructional approach. While the aforementioned changes may prove successful, the writer experienced a circumstance when none of these approaches were successful. Finally it was suggested that we needed to make the switch itself more appealing to the user. As shown in Figure 15 & 16 the student's switch has been made

more novel by attaching small toys to the surface of the switch. When he plays with the small toys on the surface of his switch it activates the rollercoaster which is positioned in front of him. Soon the student learns the relationship between the switch and the battery-operated toy. At this point the novelty items attached to the switch surface should be faded.

Figure15

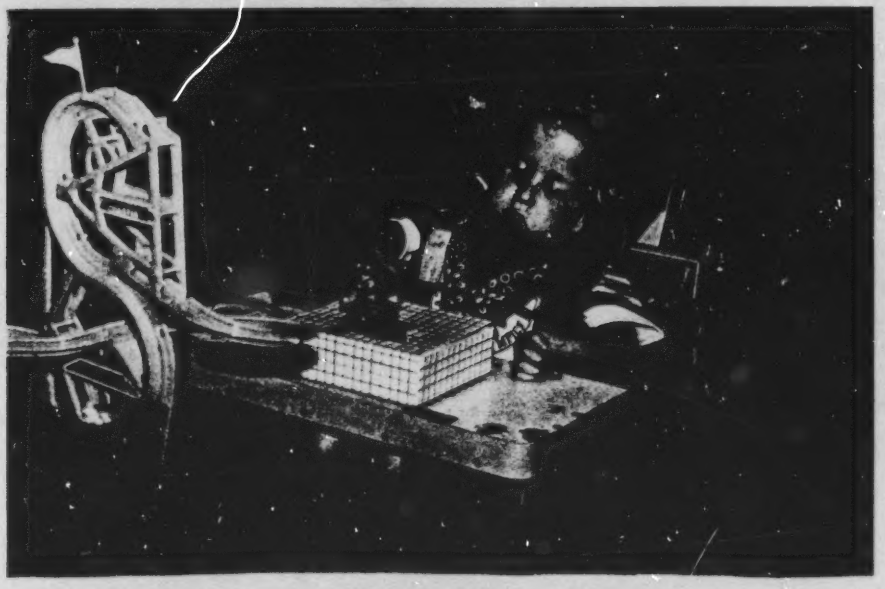
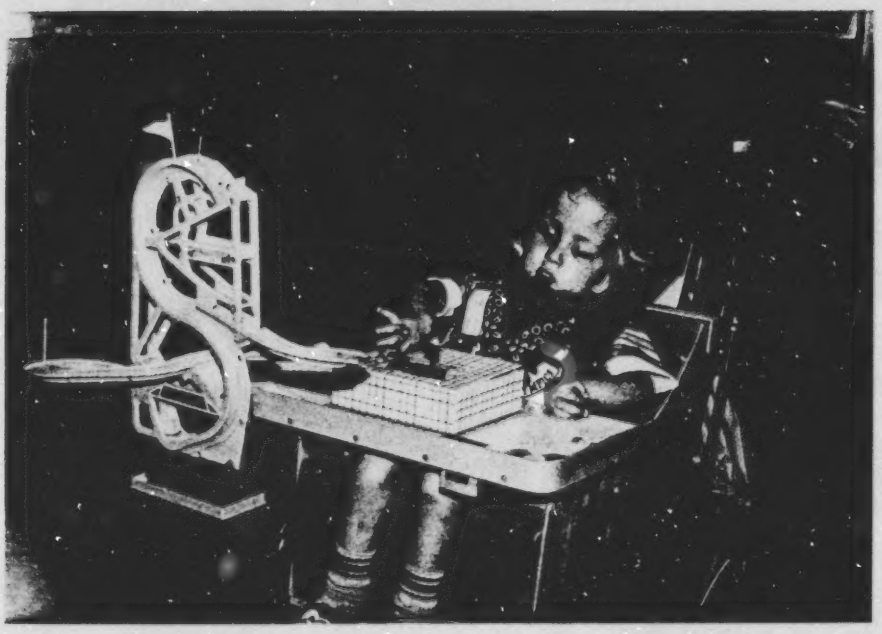


Figure 16



Providing Options

When designing mounting systems, it is not much more difficult to add more switches to give the user an option of what he/she may activate. Figures 6, 8, and 9 show switches which give the user a choice of what to activate. Figure 17 shows a three terminal mercury switch assembled with two plugs to allow for making choices. In this example (wiring described in Chapter 2 / Option IV), one of the two devices the switch is interfaced with would always be in the ON position, depending on the position of the switch. In this example, the switch is simply mounted inside a piece of plastic pipe and covered with contact paper. By positioning two interfaced devices on two levels, one high and one low, the switch inside the pipe becomes a "Magic Wand" - when you point it up the device positioned high turns ON, when you point it down the device positioned low turns ON. Only one device will be ON at a time. Whenever possible design your switches to give the user some options.

Figure 17

Mounting switches for use should be an inexpensive and fairly simple process. The examples shown in this chapter represent only a few of the numerous potential ways of mounting switches to best meet the individual characteristics of the user. Undoubtedly you will create unique options to meet special needs for individuals with whom you work, live, and play.

CHAPTER FOUR

ADAPTING BATTERY-OPERATED DEVICES FOR USE WITH REMOTE CONTROL SWITCHES

ADAPTING BATTERY-OPERATED DEVICES FOR USE WITH REMOTE CONTROL SWITCHES

In order for a remote control switch with a male plug component to operate a battery-operated device, the battery-operated device must be fitted with a compatible female remote jack. Since the vast majority of battery-operated devices are not sold commercially with a remote jack, one must be added to existing devices. Some cassette tape recorders have built-in subminiature size remote jacks. In general this process is inexpensive, able to be completed in 15 - 30 minutes with commonly available tools, and is simple enough to do that a person with little or no experience with electricity can safely and successfully adapt a device. It is important to note that the information included in this chapter is designed for use with battery-operated devices only. **It is unsafe to apply this information to electrical devices which use AC power from wall outlets.** It is also important to know that these adaptations are limited to serving an ON/OFF function. This purpose of this chapter will be to discuss considerations for selecting equipment for adaptation, directions for permanent adaptation, directions for 9V adaptation, directions for nonpermanent adaptation, adaptation of toys which have more than one switch, and adaptations of electrical devices which have built-in transformers.

SELECTION OF EQUIPMENT FOR ADAPTATION

The following section includes information to consider when deciding whether a particular device is appropriate for adaptation.

1) Determine whether there is access to the internal workings of the device. If the device is assembled with screws or clips, typically it can be disassembled. Occasionally certain types of spring-loaded devices which are assembled with screws can be extremely difficult to reassemble properly - luckily these types of devices are uncommon. Devices made of molded plastic or those covered with fur, such as toy animals, can be be more difficult to adapt. In such cases external permanent adaptation or nonpermanent adaptation may be desirable.

2) Determine if there is enough internal space for internal permanent adaptation. Some devices such as small transistor radios have extremely limited internal space. Limited internal space is one reason to use subminiature size components (plugs & jacks). Insufficient internal space may lead to external permanent adaptation or nonpermanent adaptation.

3) Determine whether the adaptation will interfere with the function of the device. For example stationary devices typically are not disadvantaged by adaptation. Conversely, some devices which move may be adversely affected by adaptation. Some toys spin, turn, or do flips, causing the wire which connects the switch and the plug to wrap around the toy and restrict its movement. Toys and devices which are mobile and small may be become unbalanced by the addition of a remote switch and jack. This may result in decreased or inconsistent performance.

4) Determine if the device is chronologically age-appropriate for the user. It is important to select devices which are compatible with the user's actual chronological age rather than their mental age. The age-appropriateness of devices may have a significant impact upon the perceptions of non-handicapped individuals. A 20 year old using a toy designed for a preschooler is likely to be perceived as a preschooler and subsequently treated like one. It is desirable for people to be treated in manner which is consistent with their chronological age.

5) Determine if the device is of interest to the learner. Whenever possible it is important to include the user in the selection decision.

6) Attempt to select devices which represent an addition to the variety of devices currently available to the user. Boredom with a single device or type of device may lead to lack of interaction with adapted devices.

7) Attempt to determine what level of supervision the device will require. If a certain device is especially appealing to the user, but

the adaptation interferes with its function, the solution may simply be that an increased level of supervision is necessary when using that device. Other devices, particularly those that are stationary should require minimal supervision.

8) Do you believe the device is worth the cost? Most battery-operated toys range in cost from $4 to $20. You are on your own with this decision.

9) If you plan to be near the user when he/she is engaged with the adapted device, can you put up with the constant output of the device? Even a patient person can listen to a "siren" or "space gun" or that "same old song" for only so long. Be kind to yourself when selecting toys and devices.

10) Try not to limit your selection to toys or devices which represent traditional gender roles. There are lots of little girls who would really enjoy cars, trucks, planes, and trains. One little boy known to the writer is especially fond of a doll which plays a tune on a guitar.

11) Consider the characteristics of the toy in relationship to the characteristics of the user. For example, if the person has difficulty tracking, then a slower moving device may be desirable. If the user has impaired visual acuity, a device which is brightly colored or has lights may be appropriate. Parents, friends, teachers, therapists, doctors, and others may be helpful in assisting with this process.

12) Determine whether the adaptation is worth the effort compared to other potentially adaptable devices or the purchase of commercially adapted devices.

Directions for Internal Permanent Adaptation

Purpose: To provide a compatible interface junction for a subminiature phone plug to which a remote control switch can be attached.

Materials: Two 6 inch pieces of stranded wire (22-24 gauge speaker wire), rosin core electronic solder, fine or medium sandpaper, heat shrink tubing 1/8" diameter, and a subminiature phone jack.

Tools: Soldering iron, drill, 3/16" drill bit, single-edge razor blade, matches, hobby vice (a spring-loaded clothespin will substitute), and a screwdriver (type and size will vary depending on the device to be adpated).

SPECIAL NOTE

It is important to remember that if you alter a device in any way permanently, the retailer from whom you purchased it will **not** accept it as a returned item. Therefore, prior to drilling any holes, changing or adding any wires, or performing any other alterations do two checks. First, put batteries in the device and test it to make sure that it works. Secondly, examine the device carefully and feel confident that you can perform the adaptation.

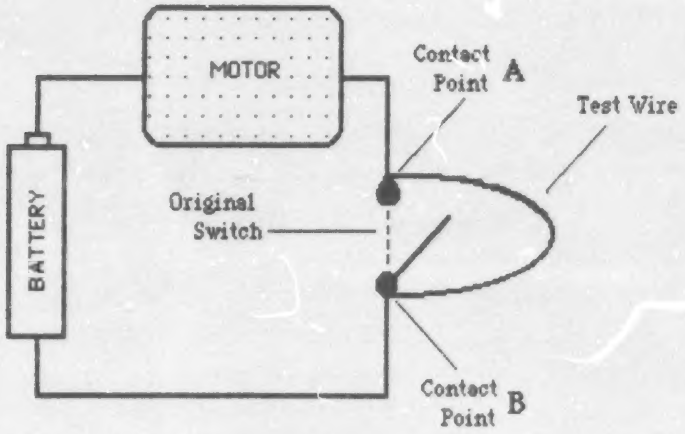
Steps

1) Select a device or toy based upon the selection considerations mentioned earlier.

2) Disassemble the toy/device in order to locate a position on the toy to mount the jack. Attempt to position it so that externally it will not interfere with the toy's operation. Internally you must ensure that there is enough depth for the three metal terminals of the jack - they should not be touching any electrical or metal components.

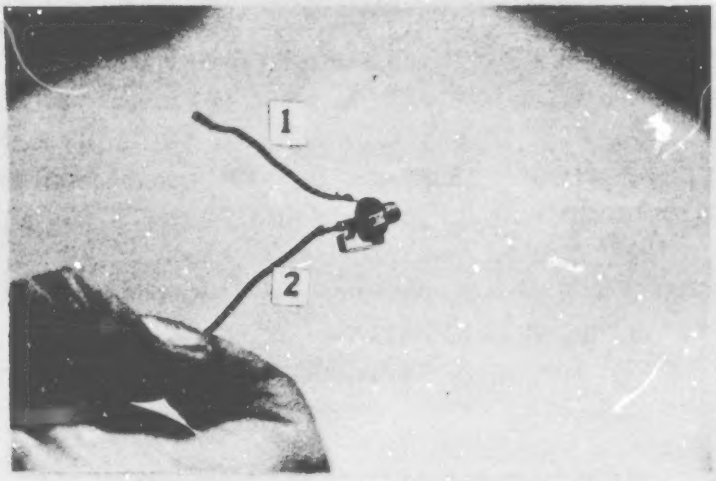
3) Using the drill, make a hole in the toy where you will mount the jack. Smooth either side of the hole using the single-edge razor blade so that both the interior and exterior surfaces are flush. Make sure the jack fits before you go any further.

4) Prior to cutting your wires to length or soldering, determine where the wires will be attached to the toy. This can be accomplished using a short coated wire that is stripped of its coating at both ends, hereafter this wire will be referred to as the "Testing Wire". By experimenting with various points on the device you can determine where to attach and solder the wires. Since every device will be different, our discussion about this procedure will be in generalities. In battery-operated devices you must have a complete circuit for the device to work (as described in Chapter 2). In the process of adapting a device you want to locate two points, which if connected would complete the circuit. Using the Testing Wire, if you simultaneously touched opposite ends of it to points A and B as depicted in the following diagram you would complete the circuit. The device would work even though the device's original switch was in the OFF position because you would have bypassed that original switch. Remember where the two points are which complete the circuit because you will need to refer to them later - we will refer to these points as "Contact Points" hereafter.



5) Determine the length of the two wires you will need in this process by estimating the distance between the hole where the jack will be mounted and the two contact points. Cut your wires accordingly. Leave a little bit extra length in case you accidentally cut the wire during stripping. Strip approximately 1/8" of insulation off both ends of the two wires.

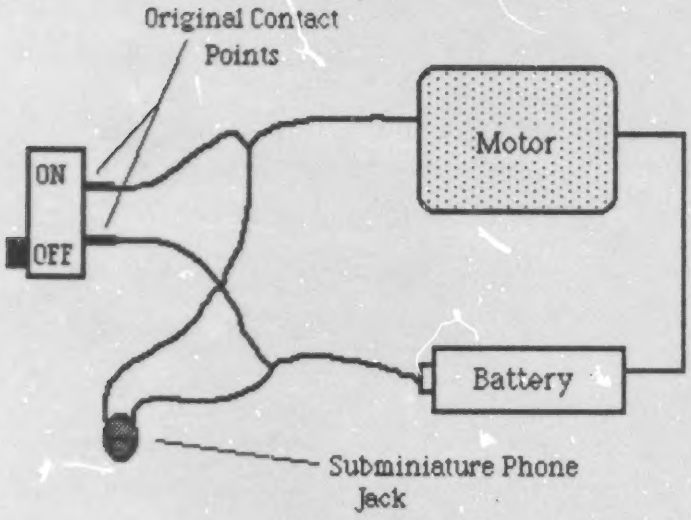
6) It is now time to attach your two wires to the jack. Secure the jack in place using the hobby vice or clothespin. Attach one wire to terminal (1) and the other wire to terminal (2). Solder both connections separately and insulate using heat shrink tubing.



7) Mount the jack on the device using the hardware packaged with the jack.

8) Solder the unattached wires to the Contact Points, one wire to each point as shown on page 11. It does not matter which wire is attached to which point. Occasionally the characteristics of the metal in the device will make it difficult for the solder to adhere properly. Try cleaning and sanding the Contact Point areas and try again. Be sure to preheat the Contact Point areas before soldering.

Helpful Hint: At times the Contact Points may be difficult to solder for any number of reasons (tiny Contact Points, insufficient space, lots of wires, inexperience adapting devices, etc.). In such cases it may be easier to extend the circuit through the wires attached to the Contact Points rather than through the actual Contact Points. Once you have identified the Contact Points, cut the wires leading from them and attach/solder them to the wires which are attached to the jack as depicted in the following diagram.



9) Test the remote switch before reassembling the device. This is done by plugging the switch into the jack and then activating the switch (the device's original switch should be in the OFF position). If it does not work first check your batteries and the recheck your solder connections.

10) Once you are sure that the device is working properly, reassemble it. The device is now finished being adapted and is ready to be used.

External Permanent Adaptation

Since battery-operated devices manufactured by commercial vendors typically were not designed for the type of adaptation discussed in this guide, some devices have limited access to internal mechanisms and/or insufficient space for mounting a jack. Given these realities, one option would be permanent adpatation as described previously with the jack being mounted externally rather than internally. The two options for permanent external adaptation are 1) where the original switch remains unchanged, and 2) where the original switch has been removed for easier adaptation. Since wires which would normally be contained inside of the device are outside of the device using this method, it is frequently necessary to drill or notch an opening through which the wires may pass.

Permanent 9V Adaptation

The most common devices powered by 9V batteries are small transistor radios. One method of adaptation which is simple to complete is described here. It is important to note that this particular method of adaptation eliminates the use of the device's original ON/OFF switch. Following adaptation the device will work only with the original switch in the ON position and the remote control switch plugged in and turned ON.

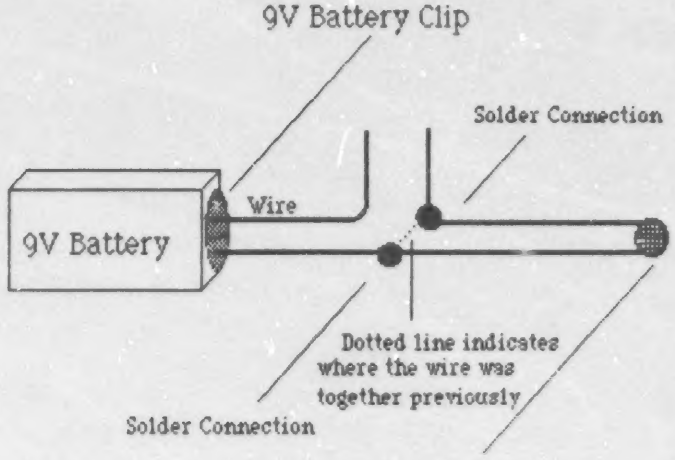
Steps:

1) Attach 2 wires (22-24 gauge) to a subminiature phone jack as shown on page 48.

2) Cut either of the two wires going from the 9V battery clip. These wires may be quite short so be sure to give yourself length with which to work.

3) Attach and solder one side of the cut wire to either of the wires attached to the jack. Don't forget to insulate using heat shrink tubing.

4) Attach and solder the remaining side of the cut wire to the remaining wire attached to the jack. Insulate using heat shrink tubing.



Subminiature Phone Jack

Nonpermanent Adaptation

There are occasions when it may be desirable to use a nonpermanent method of adaptation. This nonpermanent adaptation allows a device to be operated with a remote control switch without performing any changes to the device itself. This method is especially useful with stationary devices, devices which are difficult to disassemble, and for use with more than one device. It may also represent a simple way for you to "get your feet wet" with adaptation without having to disassemble a device. Another consideration is that devices which have been tampered with through permanent adaptation can not be returned to stores. An adaptor can be built to be used interchangeably between several battery-operated devices of the same battery size.

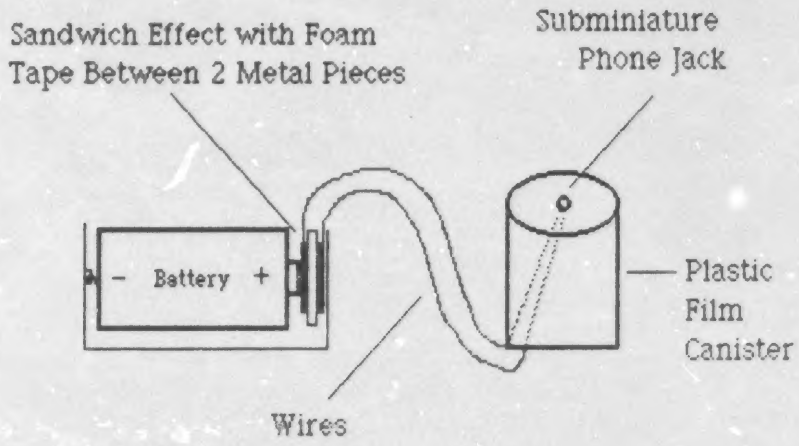
Steps:

1) Attach 2 wires (22-24 gauge) to a subminiature phone jack as shown on page 48.

2) Solder the opposite end of one of the wires from the jack to a small, thin piece of metal (copper or brass are preferable).

3) Repeat step 2 with the remaining wire from the jack to a second thin piece of metal.

4) Adhere a flat, thin piece of plastic between the two metal pieces so that they are insulated from each other completely. Double backed foam tape works well for this purpose.



In order to protect the terminals of the jack, it may be mounted in a small plastic cup (such as are used on the feet of some kitchen chairs). As pictured in the previous diagram the jack has been mounted inside of a 35mm film canister for protection. These types of protection systems may be awkward or inappropriate for some mobile toys, they are most applicable for stationary devices. **The nonpermanent adapter is used by placing the sandwiched end between the positive end of the battery and the metal contact of the device's battery holder. The device must be in the ON position. After this has been accomplished a switch may be plugged into the jack and activated in order to operate the device.**

Adaptation of Devices Which Have More Than One Switch

Several toys are available commercially which already have a wire attached to them leading to a battery pack and switches. Such toys typically come in three basic variations, 1) with a single switch which if pushed one way activates one function and if pushed the opposite way activates a second function, 2) with two separate switches which serve the same function as listed in the first variation, and 3) with two switches, each of which are separate, independent circuits activating different functions. Types 1 and 2 are interdependent for their successful operation. **These types of devices are significantly more complicated to adapt.** Think twice before you purchase this type of device for adaptation. Using stabilization and extensions on the switch are easier adaptations than trying to alter the device electrically.

Adaptation of Electrical Devices Which Have Built-In Transformers

Some toys such as model train and car race tracks sets use AC electricity from wall outlets. This electricity passes through a transformer which reduces the electricity to a safe level. Such devices can be adapted in basically two ways. A nonpermanent method of adaptation can be accomplished by the use of a "Switch Interface Relay" which is described in Chapter 5. This method requires that no alterations be made in the commercially purchased item. A permanent method of adaptation can be

accomplished by following procedures which parallel those described in the section "Permanent 9V Adaptation" on page 50. In both of these options the device's original switch must remain in an ON position and should be pre-set to the desired speed. The following table outlines the advantages and disadvantages of both methods.

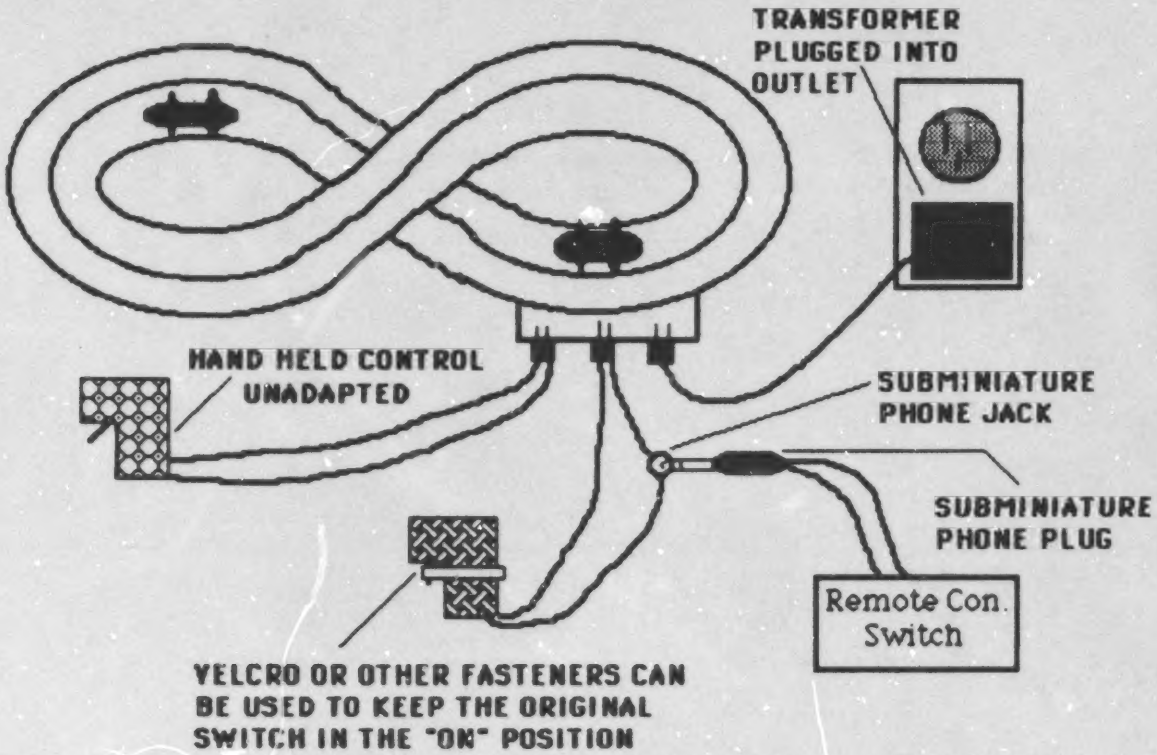
Advantages & Disadvantages

	NONPERMANENT ADAPTATION USING A SWITCH INTERFACE RELAY (SIR)	PERMANENT ADAPTATION USING A SUBMINIATURE PHONE JACK
ADVANTAGES	1. Requires no alteration of the device to be adapted. 2. Device is returnable if defective during **warranty period.** 3. Does not interfere with the function of the device. 4. Can still be used as originally designed.	1. It is inexpensive (costs less than $1). 2. Is very simple to do, requiring only one part and two solder connections. 3. In two function devices such as a race track with two lanes, one can be adapted and one can be left unchanged. This allows for participation by handicapped and nonhandicapped persons at the same time.
DISADVANTAGES	1. Requires access to a Switch Interface Relay (SIR). This can be built for approximately $20. They are commercially available for $200 - $315 from vendors. 2. A Switch Interface Relay (SIR) is more complicated to assemble than the other adaptations described in this guide.	1. Can not be returned to the seller follow-any permanent adaptation if it is defective. 2. May interfere with the function of the device. While the device will work, the alteration may reduce the already low voltage going to operate the device. The result may be decreased power and performance.

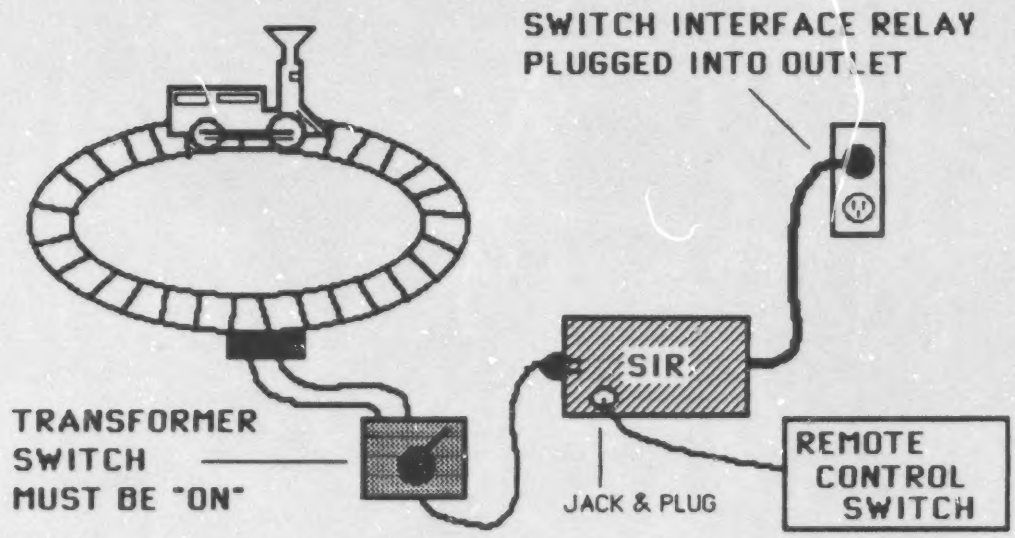
The following diagrams depict electrical devices adapted using both permanent and nonpermanent methods.

BEST COPY AVAILABLE

PERMANENT ADAPTATION WITH TRANSFORMER DEVICE



NONPERMANENT ADAPTATION WITH TRANFORMER DEVICE



BEST COPY AVAILABLE

TROUBLE SHOOTING

1. Always test the device prior to adapting it to ensure that it works properly and that it meets the needs of the user.

2. If the device is not working or is sluggish, always check the batteries first. Check for strength and contact.

3. Remember that certain adapted devices will only work with a remote control switch, while others can be operated in an adapted fashion or as originally designed.

4. If you are using a nonpermanent adapter be sure that it is properly positioned and that the device's original switch is in the "ON" position.

5. Make sure that the switch you are using to test your adapted device is operating properly.

6. Check all the solder joints for good connections. Occasionally wires will break - especially on permanent external adaptations.

7. If you can not locate the source of the problem yourself, ask a friend who is more experienced with electricity.

Adapting battery-operated devices is a process that you can learn to do. Everytime you adapt a device it will improve your skills and you will learn little tricks that will help you in the future adaptation projects. Doing it yourself can save money, as well as give you more control over the selection of devices to be adapted.

BUILDING A SWITCH INTERFACE RELAY (SIR)

CHAPTER FIVE

NOTE: THE SWITCH INTERFACE RELAY USES AC ELECTRICITY. WHILE THIS SYSTEM IS SAFE, THERE IS ALWAYS A RISK WHEN USING HIGHER LEVELS OF ELECTRICITY, THEREFORE FOLLOW THE INSTRUCTIONS CAREFULLY AND HEED ALL SAFETY WARNINGS. DO NOT FORGET TO HAVE THE SIR CHECKED OUT BY A QUALIFIED TECHNICIAN PRIOR TO USE.

IF ASSEMBLED PROPERLY THIS DEVICE CAN BE USED SAFELY AND SUCCESSFULLY .

BUILDING A SWITCH INTERFACE RELAY (SIR)

While the use of battery-operated devices is useful in providing a measure of environmental control, it is limited by those devices which use batteries as a power source. The purpose of this chapter is to detail the use and assembly of a Switch Interface Relay (SIR). The SIR allows a person with a severe motor disability to activate a variety of electrical devices which use electrical current from wall outlets such as radios, televisions, tape players, food processors, blenders, small microwave ovens, can openers, lights, car race tracks and model train sets. This approach avoids the necessity of adapting each device individually while providing a safe, inexpensive, interchangeable method of providing environmental control with chronologically age-appropriate devices. The SIR is an example of how the "Principle of Partial Participation" (Baumgart, Brown, Pumpian, Nisbet, Ford, Sweet, Messina, & Schroeder, 1982) can be operationalized. Although the SIR must be set up with a device by someone else for the user, it increases the potential for participation in domestic, leisure, community, and vocational activities.

Table 1 : Tools Required to Assemble a SIR

1) Drill (electric or hand)
2) Drill Bits (3/4" & 11/64")
3) Screwdriver (size may vary)
4) Phillips Head Screwdriver
5) Coping Saw Blade
6) Wood Rasp (fine)
7) Needlenose pliers
8) Wire Cutter/Stripper
9) Matches
10) Soldering Iron
11) Utility Knife

Table 2
Consumable Materials Required to Assemble a Switch Interface Relay (SIR)

All parts listed below may be purchased at Electrical Supply Outlets or Radio Shack Stores

Materials	Quantity	Cost
1) Plastic Project Case (approximately 7.5" x 4.5" x 2.25")	1	2.99
2) 12VDC DPDT Relay enclosed in plastic casing (10 amps at 125VAC)	1	5.49
3) "C" Cell battery holder (holds 2 "C" cells) 3a) red wire 3b) black wire	1	.99
4) Subminiature phone jack (closed circuit) 4a) terminal connected directly to the jack's cylinder (this is terminal 1 as pictured on page 48) 4b) terminal connected to the tip contact (this is terminal 2 as pictured on page 48)	1	.60
5) Battery holder clip for 9V rectangular battery	1	.30
6) 9V battery replacement snap 6a) red wire 6b) black wire	1	.20
7) Heat shrink tubing (1/4" diameter x 1/2" length)	2	.10
8) Heat shrink tubing (1/8" diameter x 1/2" length)	5	.20
9) Double sided foam tape (7")	1	.27

10) "C" Cell batteries (1.5 volts each)	2	.68
11) 9V Transistor battery	1	.59
12) 22 gauge speaker wire (6" single piece)	1	.02
13) Solder (rosin core electronic, 1")	1	.10
14) Romex Connector (3/8")	1	.25
15) Power cord (14 gauge, 3 conductor SJTO wire, 7') 15a) white wire 15b) green wire (ground) 15c) black wire	1	1.75
16) Heavy-duty, backwired, grounded plug	1	1.39
17) Medium wire connectors (plastic)	2	.20
18) Snap-in receptable (panel mount type) (grounded with lead wires) 18a) white wire 18b) green wire (ground) 18c) black wire	1	1.29
19) Silicon sealant (small tube)	1	2.00
20) Nylon Tie	1	.10
TOTAL APPROXIMATE COST EXCLUDING TAX		**19.51**

(Some items listed above must be purchased in quantities greater than needed fo. his project)

Steps:

1) Gather the tools listed in Table 1 and the materials listed in Table 2. In the remaining steps, numbers following listed materials correspond

with those listed on Table 2 and those represented on the wiring diagram in Figure 1 on page 63.

2) Remove the project case (1) lid and drill a 3/4" hole in the center of the left end of the plastic project case.

3) Drill a 11/64" hole in the near side of the plastic project case approximately 2 1/4" from the end with 3/4" hole, and 1" from the bottom.

4) Make an opening in the center of the end opposite the 3/4" hole to accomodate the snap-in receptacle (18). First, mark the opening corresponding to the part of the receptacle that will fit through the wall of the project case. Drill 11/64" holes on the inside of each corner of the marked opening. Use the coping saw blade to cut out the piece. Be conservative when cutting the plastic. It is preferable to have the opening be too small initially. Use the wood rasp to file the sides until you achieve a snug fit.

5) Snap the receptacle (18) in place.

6) Insert and secure the Romex connector (14) in the 3/4" hole. Use the wood rasp to widen the hole slightly if necessary.

7) Attach the grounded plug (16) to one end of the power cord (15). Attach the green wire inside the power cord to the ground prong terminal. Attach the black wire to the "hot" prong terminal which is identified by being connected to the smaller of the two flat prongs or by a gold colored screw. Attach the white wire to the remaining terminal which is identified by being connected to the larger of the two flat prongs or by a silver colored screw.

8) At the opposite end of the power cord (15), remove approximately 4 and a 1/2 " of the outer rubber insulation. At the end of each of the three interior wires, strip approximately 1/4" insulation. Thread the power cord through the Romex connector (14) so that approximately 1/4" of the rubber insulation is showing inside the project case. Clamp the wire down using the Romex connector.

9) Using the wire connectors (17), connect the green wire (18b) from the snap-in receptacle (18) to the green wire (15b) from the power cord (15). Repeat the same procedure with the white wires (18a & 15a).

10) Slide a piece of 1/8" heat shrink tubing (8) over the red wire (6a) of the 9V battery replacement snap (6). Solder the end of the red wire (6a) to the subminiature phone jack terminal (4b). In the photo on page 48 the top wired terminal is (4b) and the lower wired terminal is (4a). After soldering, slide the heat shrink tubing over the solder joint and heat with a match.

11) Slide a piece of 1/8" heat shrink tubing (8) over the black wire (6b) of the 9V battery replacement snap (6). Solder the black wire (6b) to the red wire (3a) of the "C" cell battery holder (3). After soldering, slide the heat shrink tubing over the solder joint and heat with a match.

12) Slide a piece of 1/8" heat shrink tubing(8) over one end of the single piece of speaker wire (12). Solder the wire (12) to the subminiature phone jack terminal (4a) which is the lower wired terminal pictured in the photo on page 48. After soldering slide the heat shrink tubing over the solder joint and heat with a match. Mount the subminiature phone jack (4) to the project case (1) in the 11/64" hole drilled in step 3. For extra safety a 1" long piece of 3/8" diameter heat shrink tubing can be applied over the portion of the jack extending into the interior of the project case. This will insulate the jack from any potential contact with other metal components inside of the project case.

13) Secure the "C" cell battery holder (3) to the bottom of the project case using silicon sealant. Refer to Figure 1 on page 63 for the approximate location of the battery holder in the project case.

14) Slide a piece of 1/8" heat shrink tubing over the end of the black wire (3b) of the "C" cell battery holder. Solder the black wire (3b) to one coil terminal (2a) of the 12VDC DPDT relay (2) - refer to Figure 1. After soldering, slide the heat shrink tubing over the solder joint and heat with a match.

15) Slide a piece of 1/8" heat shrink tubing over the unattached end of the single piece of speaker wire (12). Solder the wire (12) to the remaining coil terminal (2a). After soldering, slide the heat shrink tubing over the solder joint and heat with a match.

16) Slide a piece of 1/4" heat shrink tubing (7) over the black wire (18c) of the snap-in receptacle (18). Solder the black wire (18c) to the "normally open" terminal (2c) of the 12VDC DPDT relay (2). After soldering, slide the heat shrink tubing over the solder joint and heat with a match.

17) Slide a piece of 1/4" heat shrink tubing (7) over the black wire (15c) of the power cord (15). Solder the wire (15c) to the "common" terminal (2b) of the 12VDC DPDT relay (2). After soldering, slide the heat shrink tubing over the solder joint and heat with a match.

18) Insulate the remaining exposed terminals on the relay using heat shrink tubing (8) on each.

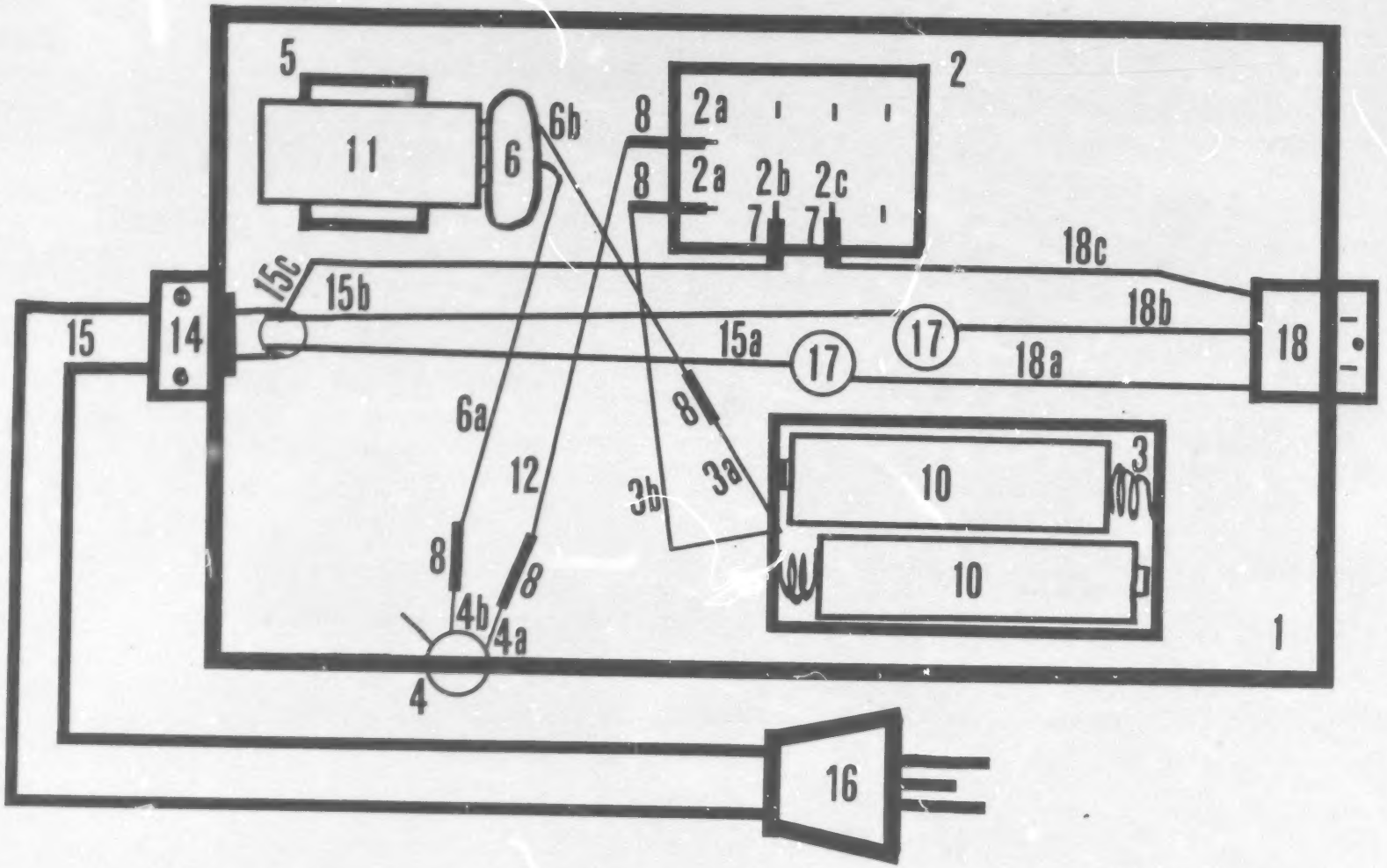
19) Secure the relay (2) to the project case (1) using silicon sealant (19) on the surface opposite the terminals, and on the side which contacts the wall of the project case. When completed, the relay should be affixed to the floor and side of the project case with the terminals facing up. Refer to Figure 1 for the approximate location of the relay in the project case. Follow the directions on the tube of silicon sealant regarding its use.

20) Secure the battery holder clip for the 9V battery (5) to the floor of the project case using the silicon sealant. Refer to Figure 1 for the approximate location of the 9V battery holder in the project case.

21) Tie wires (15c) and (15b) together using a nylon tie.

22) After the silicon has dried completely place two "C" cell batteries (10) in the "C" cell battery holder (3) and attach a 9V battery (11) to the 9V snap (6) and place it in the holder (5). Screw the lid back on the project case.

Figure 1. Wiring Diagram of a Switch Interface Relay (SIR)



23) Place a label on the lid of the project case which states the following:

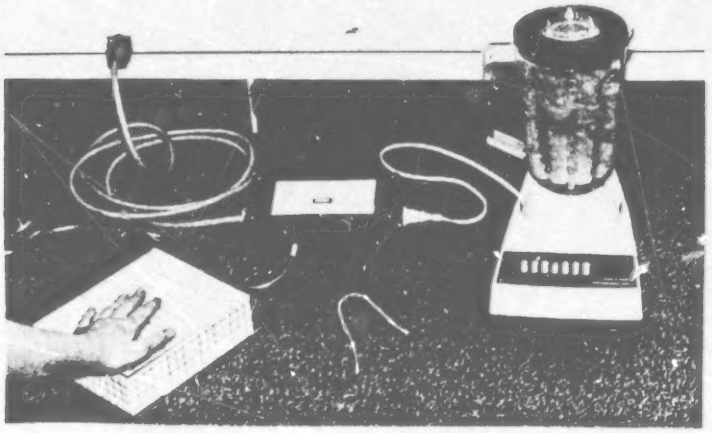
SWITCH INTERFACE RELAY (SIR)

Directions: ***Plug remote control switch (with subminiature phone plug) into the jack on the side of the project case. Plug an appliance rated at 10 amps or less into the receptacle on the end of the project case. Turn the appliance to the "ON" position. Plug the power cord of the SIR into a grounded wall outlet. The appliance may now be controlled by activating the remote control switch.***

Caution: ***DO NOT USE WITH ANY DEVICE RATED ABOVE 10 AMPS ! PROVIDE PROPER SUPERVISION. KEEP THE SIR OUT OF THE USER'S REACH. (watts divided by volts - Amps).***

24) Have the SIR checked for safety by a qualified technician **before** use. Batteries will need to be replaced intermittently. Impact or other rough treatment may cause the batteries to dislodge or other more serious damage. Examine the interior of the SIR at regular intervals as a preventative maintenance precaution.

Figure 2. Switch Interface Relay Set-up for Operation



SAFETY FEATURES OF THIS SIR SYSTEM

1) All plastic, fully enclosed box.

2) The relay itself is fully encased in plastic.

3) The relay coil is operated by 12V DC power.

4) All unused relay terminals are insulated.

5) Relay and battery holders are affixed to the project case using silicon sealant for long-term flexible adhesion.

6) The SIR's power cord plug and receptacle are both grounded.

7) The power cord is secured using a heavy-duty strain relief.

8) The heavy-duty power cord meets electrical code requirements for 10 amps.

9) The hot wire (15c) from the power cord is tied to the ground wire (15b) with a nylon tie to restrict potential movement in case of impact.

10) All solder joints are insulated with heat shrink tubing.

11) Subminiature phone jack terminals are insulated individually and collectively.

12) Assembly directions include a safety check by a qualified technician.

13) Instructions for use of the SIR are conspicuously located on the top of the SIR.

Summary:

The Switch Interface Relay (SIR) described in this article represents one, simple to construct, portable method of providing appropriate environmental control for persons with severe motor impairments within the context of partial participation. The use of this inexpensive, durable,

interchangeable device may provide new access to a variety of common chronologically age-appropriate toys, games, and appliances. Such devices allow the user to advance from being a passive observer to being an active participant.

REFERENCE

Baumgart, D., Brown, L., Pumpian, I., Nisbet, J., Ford, A., Sweet, M., Messina, R., & Schroeder, J. (1982) Principle of partial participation and individualized adaptations in educational programs for severely handicapped students. ***Journal of the Association for the Severely Handicapped, 7,*** (2), 17 -27.